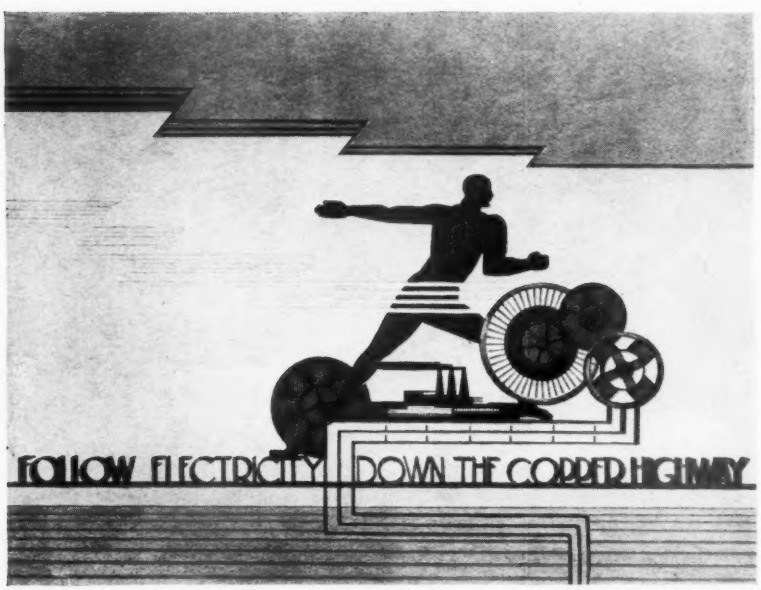
EDISON ELECTRIC INSTITUTE BULLETIN



Courtesy "Electricity at Work"

VOLUME 1 SEPTEMBER 1933 NUMBER 6

STATISTICAL DATA OF THE ELECTRIC LIGHT AND POWER INDUSTRY

Compiled Monthly by the Edison Electric Institute—Covers 100% of the Industry

DURING THE MONTH OF JULY

	1933	1932	%
Kilowatt-hours Generated* (net)			
By fuel	4,390,664,000	3,605,654,000	+21.8
By water power	2,532,667,000	2,439,884,000	+ 3.8
Total kilowatt-hours generated	6,923,331,000	6,045,538,000	+14.5
Additions to Supply			
Energy purchased from other sources	213,954,000	193,137,000	+10.8
Net international imports	66,364,000	34,317,000	+93.4
Total	280,318,000	227,454,000	+23.2
Deductions from Supply			
Energy used in electric railway depts.	47,068,000	63,772,000	−26.2
Energy used in electric and other depts.	97,981,000	97,045,000	+ 1.0
Total	145,049,000	160,817,000	− 9.8
Total energy for distribution	**7,058,600,000**	**6,112,175,000**	**+15.5**
Energy lost in transmission, distribution, etc.	1,298,674,000	1,142,922,000	+13.6
Kilowatt-hours sold to ultimate consumers	**5,759,926,000**	**4,969,253,000**	**+15.9**
Sales to Ultimate Consumers (Kw-hrs)			
Domestic Service	866,876,000	853,740,000	+ 1.5
Commercial—Small light and power (retail)	1,013,208,000	1,006,889,000	+ 0.6
Commercial—Large light and power (wholesale)	3,309,822,000	2,549,780,000	+29.8
Municipal street lighting	150,296,000	162,639,000	− 7.6
Railroads—Street and interurban	301,700,000	309,194,000	− 2.4
Railroads—Electrified steam	56,151,000	40,512,000	+38.6
Municipal and miscellaneous	61,873,000	46,499,000	+33.1
Total sales to ultimate consumers	5,759,926,000	4,969,253,000	+15.9
Total revenue from ultimate consumers	$143,211,700	$140,986,100	+ 1.6

DURING TWELVE MONTHS ENDING JULY 31st

Kilowatt-hours Generated* (net)			
By fuel	45,198,180,000	51,158,421,000	−11.7
By water power	31,373,142,000	29,261,940,000	+ 7.2
Total kilowatt-hours generated	76,571,322,000	80,420,361,000	− 4.8
Purchased energy (net)	2,707,349,000	2,676,102,000	+ 1.2
Energy used in electric railway and other depts.	1,946,156,000	2,206,288,000	−11.8
Total energy for distribution	**77,332,515,000**	**80,890,175,000**	**− 4.4**
Energy lost in transmission, distribution, etc.	13,089,870,000	13,766,947,000	+ 2.3
Kilowatt-hours sold to ultimate consumers	**63,242,645,000**	**67,123,228,000**	**− 5.8**
Total revenue from ultimate consumers	1,774,933,500	1,900,358,000	− 6.6
Important Factors			
Percent of energy generated by waterpower	41.0%	36.4%	
Average pounds of coal per kilowatt-hour	1.46#	1.49#	
Domestic Service (residential use)			
Average annual consumption per customer (kw-hr)	600	595	+ 0.8
Average revenue per kw-hr (cents)	5.55¢	5.63¢	− 1.4
Average monthly bill per domestic customer	$2.78	$2.79	− 0.4

BASIC INFORMATION AS OF JULY 31st

Generating Capacity (kw)—Steam	24,026,300	24,080,400	
—Water power	8,975,100	8,887,900	
—Internal combustion	461,500	450,600	
Total generating capacity in kilowatts	33,462,900	33,418,900	
Number of Customers			
Farms in Eastern Area (Included with Domestic)	(504,220)	(500,100)	
Farms in Western Area (Included with Com'l—Large)	(204,032)	(207,879)	
Domestic Service	19,709,378	19,923,633	
Commercial—Small light and power	3,674,819	3,691,096	
Commercial—Large light and power	526,404	559,412	
All other ultimate consumers	62,439	62,337	
Total ultimate consumers	23,973,040	24,236,478	

*By courtesy of the U. S. Geological Survey with deductions for certain plants not considered Electric Light and Power Enterprises.

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EDISON ELECTRIC INSTITUTE BULLETIN

Volume 1 SEPTEMBER, 1933 Number 6

NOTES ON COMMERCIAL ACTIVITIES

By C. E. GREENWOOD

RECORDS AND TRENDS

Business is definitely picking up in some lines. There has been selective purchasing as people have bought items having greatest appeal in anticipation of price increase. For example, in the zero hours of hesitant business, electric refrigerator sales break the record. The first year goal of our Electric Refrigeration Bureau—1,000,000 refrigerators—will be realized unless all signs fail. Electric oil burners and electric clocks have followed with peak sales records.

But domestic revenue has been easing off, an unfailing indication that in view of the added kilowatt-hour output due to the operation of these automatic electric household servants, the smaller appliances are idle or fewer incandescent lamps are burning, and smaller wattage lamps are trying to do the same work as the larger ones.

There is little doubt that thrift in the use of light is making greatest inroads into our revenue. The Lighting Program is timely and we must make it effective.

BETTER LIGHT—BETTER SIGHT

Lighting activity — meaning major lighting sales plans—has been developed by local utilities from Coast to Coast. "Lighting News," the publicity medium of the National Lighting Program Committee, under the Chairmanship of M. E. Skinner, Assistant Vice-President, Niagara Hudson Power Corporation, which is published semi-monthly, tells the story of mass action in the sale of better light for better sight which is rolling up like the proverbial snowball. The peak months for tie-in are October and November. It will be a strange company that is not in the mobilized ranks.

Lined up with the utilities locally are the manufacturers of lamps and lighting equipment, wholesalers, electrical contractors and building contractors, department, hardware and furniture stores. As Mr. George E. Whitwell, Chairman of the Sales Committee of the Institute, has often repeated, "We are not mobilized for a 'flash' program. Once started, we must continue until the handicaps to public appreciation of their lighting needs are vanquished."

To induce constant and widespread repetition of the slogan a lapel button produced by the Lighting Program Committee will serve to remind everyone of the need for better illumination.

Special illumination numbers are being issued by the trade press, among them being *Electrical World*, *Electrical Merchandising*, *Electric Light & Power*, and the *American Builder*. The latter journal will run a series of articles for one year addressed to the smaller building contractor particularly.

If you are not now marching under the banner of "Better Light—Better Sight," join the ranks for cooperation with profit. We have a job of education and selling ahead.

RANGE WIRING

To encourage a backward electrical service, and speed pioneering and educational development of electric cooking, many utility companies have established a "free" wiring offer. The wiring is "free" to the customer, but it is really bought of the local electrical contractor and paid for by the company.

A survey of this promotional practice in June of this year made possible an analysis of 142 replies covering 14,640 communities. Forty-seven companies were offering free wiring, and 18 other companies were making the free offer limited to trial installations of electric ranges only. There were 131 companies in the group using a coordinated plan of appliance promotion with the dealers.

RANGE RENTAL

It is of further interest that of the 142 companies answering this same questionnaire in the early summer, 11 were already attempting a "Rental Plan" to induce customers to learn about electric cooking and its advertised merits through *use*. The notion of "try it and be convinced," or "ask the woman who uses one" has influenced the "Rental Plan," but mostly on a limited basis.

The urgency for new business as increased taxes on the one hand, and arbitrary rate reductions on the other, bear down on the utility, and force drastic methods for increasing revenue, has been an influencing factor in these innovations. The number of companies making the experiment have increased in recent months. It will take several months of study of this practice of "exposing" the prospect to electric cooking before one can take a measure of its merits. Some companies are already gratified with the results obtained.

The *method* employed in promoting electric cooking on the "Rental Plan" will be an important factor in determining its effectiveness. We realize

that there is nothing new in this form of promotion on the other side of the ocean. For several years the "Hire" and the "Hire-Purchase" plan have been methods employed in English companies for promoting electricity as a cooking fuel.

ANOTHER RACKET SHATTERED

One of the baffling problems of the present era is the so-termed "racket" familiar to numerous classes of business. The electrical industry has been affected by some of them. Perhaps most vicious in intent, though comparatively harmless, have been the publications of a gentleman from Minneapolis which have attempted to scare present and prospective users of electric refrigerators into believing that this useful household servant is a breeder of Cancer. For three years, at least, through writings and illustrations distributed to American homes with the aid of short-sighted individuals and competitive groups, this scare propaganda has been increasing in volume and intensity. The crowning achievement was the booklet entitled, "Cancer, the Potential Penalty of Electric Refrigeration."

In the meantime the curve of sales of electric refrigerators has been upward. But so many inquiries have been received at the general office of the Institute that it will be interesting for readers of the BULLETIN to know that not only has the Better Business Bureau made investigation, but *The Journal* of the American Medical Association, has spoken forcibly in an editorial in the August 12th issue of *The Journal* which we have permission to reprint. The editorial follows:

"REFRIGERATION AND CANCER"

"A False Propaganda"

"Recently an attempt has been made to connect the apparent increase in cancer, the prevalence of dental caries and certain other less definite types of ill health with the growth in the use of mechanical refrigeration. Whenever industries are involved in propaganda in the health field, the commercial motive is naturally suspected. The Journal has no brief for any interest involved in the dissemination of such claims nor is it concerned except from the point of view of the public health in the claims made for mechanical refrigeration as opposed to the use of ice. It does have an interest in proper interpretation of statistics concerning the public health, in order that the public may not be led into fallacious beliefs or unwarranted fears.

"Inquiries have come to The Journal from physicians, health officers and better business bureaus in widely separated parts of the country relative to the propaganda concerned.

(Continued on page 184)

ORGANIZATION, SCOPE AND OPERATION OF THE ELECTRICAL EQUIPMENT COMMITTEE

Organization

The Electrical Equipment Committee has been formed with 15 members plus the chairman. It is organized, and will operate on a sponsor basis. It is the intention that each committee member shall be sponsor for some specific division of the work. The work has been classified in three divisions and the membership divided into three corresponding sponsor groups, each group having a chairman to coordinate the work of the division. The three divisions and corresponding group chairmen are as follows:

1. Meters and Utilization Equipment—J. E. Fairman
2. Station and Substation Equipment—H. W. Eales
3. System Equipment Engineering and Operation—S. M. Dean

Scope

The scope of the Committee has been defined as follows:

"To study the technical characteristics of electrical equipment commonly or principally used in stations and in the measurement and utilization of electrical energy; to study the broad engineering and economic problems involved in the applications and use of electrical equipment in power systems; to guide the economic development of improved designs and practices and to record progress in these fields."

Method of Operation

It is the intention that the necessary work shall be carried on through existing agencies such as group representation on A.S.A. or joint industry committees, etc., insofar as possible. Working subject committees on specific subjects will be appointed only in cases where no adequate and suitable agency exists. Such subject committees are not to be established except with the approval of the Operating Committee of the Institute and all such formal appointments require the previous approval of the executives of the member companies by which the proposed appointees are employed. It is the intention that existing member company organizations shall be utilized insofar as possible in carrying out the detail work of the various projects. These company groups may be informally supplemented by cooperation with other similar groups where contacts between such groups can be conveniently established, as for instance where several company organizations are located in the same or neighboring cities, or where the work is such that it can be carried on by correspondence. Group meetings involving appreciable traveling expense should be held only by formally authorized and organized groups.

Duties of Sponsors

It shall be the duty of each duly appointed sponsor to initiate, supervise, coordinate, edit and interpret to his Sponsor Group and to the Committee the work on the subjects for which he is sponsor: also to interpret to the groups carrying on the detail work the wishes, opinions and reactions of the Committee or the Sponsor Group. Each sponsor should canvass the field assigned to him and apply his best judgment as to what work should be done, the adequacy of the existing agencies for doing it, and make recommendations accordingly, first to the chairman of the group to which he belongs, and after approval by the group, to the committee at a meeting or to the Chairman if action between meetings is considered imperative. Sponsors should especially watch developments in their respective fields, both technical and commercial, and be prepared at any time to make such recommendations for action as the occasion, in their judgment, demands.

Chairmen of Sponsor Groups should coordinate the work of the individual sponsors in their respective groups, exercise judgment as to the relative importance of the various proposed activities, endeavor to prevent unnecessary duplication of effort and in general exercise supervisory judgment over the work of the group. They should make such recommendations to the Committee as to the work done or to be done as their judgment, reinforced by that of their Sponsor Group, shall indicate.

Current Activities

For the present the active work of the Committee has been limited to the following subjects:

A—*Meters and Utilization Equipment*	*Sponsor*
1. Meter Mountings	A. E. Silver
2. Fractional H. P. Motors	J. F. Fairman
3. Motor Starting Currents	J. F. Fairman
4. Service Entrance Cable	J. F. Fairman
5. Energy Diversion	A. E. Silver

Formal Subcommittees have been formed on Subjects A-1 and A-5.

(Continued on page 176)

THE CENTURY OF PROGRESS EXPOSITION AND THE ELECTRICAL INDUSTRY

By GEORGE B. CORTELYOU
President Edison Electric Institute

Remarks made at exercises dedicating the Electrical Building at the Century of Progress Exposition, Chicago, June 7, 1933. These exercises also comprised the Wednesday afternoon session of the first annual convention of the Edison Electric Institute

This Exposition is a symbol of the unconquerable spirit of this great inland metropolis. It is a sweeping challenge to the disruptive forces which menace this country and the world. It is a proclamation of confidence in the future of America.

The electric light and power industry is proud to associate itself with this spirit and with this confidence. It is still a young industry, having just completed its fifthieth year. In the "century of progress" which this Exposition celebrates and exemplifies, the electrical industry starts at the half-way mark. Yet in that brief time it has transformed the physical world. Divest this Exposition of all traces of electric light and power, and how different would be the picture presented to us; for it is the distinction of this industry that in addition to its own direct contributions to human welfare it has made possible the development in their present form of many other great industries.

Mr. Rufus Dawes, President of the Exposition, has set aside this day as Electrical Day and has invited the Edison Electric Institute to participate in the exercises which will formally open the buildings dedicated to showing the progress that has been made in electrical science and to showing the multitude of uses of electricity in its service to mankind. In behalf of this Institute and of the Electric Light and Power Industry which it represents, I wish to thank Mr. Dawes and the officers of the Exposition for this courtesy. I desire also to thank Mr. E. W. Lloyd, Chairman of the Central Station Exhibit Committee, and those who have assisted him in developing so creditable an exhibit.

A great American President once said: "Expositions are the timekeepers of progress." Some who will visit this wonderful Exposition also saw the great World's Columbian Exposition of 1893, and they will recall how the public then marveled at the profusion of electric lights which to them seemed to turn the darkness of the night into day. But how completely the lighting display of 1893 would pale into insignificance by comparison with the brilliant light and color of this Exposition!

The Edison Electric Institute is fortunate, and it is not without design, that its first convention, which is now being held, should come to Chicago during the city's second great Exposition. The 1893 Exposition in its day played an important role in advancing the electrical art by bringing to the attention of the world at that time the great promises of electrical development. Unquestionably, the electrical exhibits which we are about to dedicate at this Exposition will likewise render a notable contribution by depicting in a colorful and striking manner the early, as well as the most recent, steps in the course of electrical progress.

This first Convention of the Institute is both a beginning and a continuation. It is the beginning of a new organization, with a new constitution, a new code and a new outlook, and at the same time it is a continuation of the essential work of the predecessor organization, the National Electric Light Association. It is an interesting coincidence that the first meeting of the National Electric Light Association was held in this city in 1883; and now nearly a half-century later in the same city we begin with the Edison Electric Institute a new cycle which we hope will mark still greater advances in efficiency and standards of conduct and performance of the electric light and power industry than have been achieved hitherto.

One of the principal considerations which led to the organization on January 12, 1933, of the Edison Electric Institute and the dissolution on February 15 of the National Electric Light Association was the feeling which was quite generally held of a necessity to effect a radical simplification in the size and character of the trade association of the electric light and power industry and to make a corresponding curtailment in its cost.

Another important factor in the decision to organize a new trade association in the industry was the need which had been felt for a number of years for an organization that had the power to exercise some degree of discipline over its members with respect to their business practices. The events of the past few years brought this need particularly to the fore, and the Constitution of the Edison Electric Institute, to which all members must subscribe, places in the hands of the Membership Committee and the Board of Trustees the needed authority

to permit this control. It provides that the business practices of any company member may be investigated and such member may be expelled or otherwise disciplined for violation of proper or ethical practices or for failure to furnish information as called for under the provisions of its Constitution. The important business principles to which company members must agree to bind themselves provide for the publication of financial statements setting forth specified information. They require the certification of these statements by independent firms of certified public accountants after audit of the books of the companies. They require that all statements and data furnished to consumers, stock exchanges, stockholders, all information designed for public dissemination, and all reports to governmental authorities shall be vouched for as to their accuracy and shall clearly indicate their source. Another requirement is that all contracts between member companies involving the furnishing of management, supervisory, construction or financing services to operating electric utility companies shall be so drawn and so carried out in practice that the charges to the operating company shall be reasonable and commensurate with the value of the services rendered and the fair cost thereof to the company furnishing the services.

The Edison Electric Institute undertakes to present facts relating to the industry at large, for the information of all interested persons and governmental bodies. But each individual company must put its own facts before its local public. The local companies have a responsibility to take a vigilant and if necessary a militant stand against the misrepresentation and falsification that all too often are labeled as facts and circulated to the detriment of the industry. They must make a vigorous defense whenever they are unjustly attacked and so far as possible must forestall attack by keeping their consumers fully advised as to their business, their facilities and their service. The public has a right to know the facts—indeed, must know them—if it is to form just judgments. The public's right is the utility's duty.

I have referred in this brief fashion to the Edison Electric Institute because I feel that its importance to the Electric Light and Power Industry, and therefore to the public generally, warrants a statement regarding this newly organized trade association whose member companies produce 70 per cent of the electricity generated in this country.

Dr. Charles Proteus Steinmetz once remarked: "There is more romance in modern industry than in all history." I believe that the exhibits confined within this Electrical building and its sister building devoted to radio and communications will confirm the justice of that remark. The dominant feature of the sculptural decoration of the Electric building is low relief panels, 50 ft. square, which delineate man's struggle to wrest power from nature. Between these panels is an entirely new and striking effect, obtained electrically, in brilliant colors harmonizing with the pigmentation on the building.

On one panel and inscribed under a heroic figure representing Light, are the words:

"Light is the beginning of all Things. From the utmost ether it issues shaping the stars, answering in its patterns to the majesty of creative thought."

Under the other powerfully-sculptured figure, symbolizing Energy, is written:

"Energy is the substance of all things —the cycles of the atoms, the play of the elements are in forms cast as by a mighty hand to become the world's foundations."

Within this building are the splendid electrical exhibits. Among those of the electric light and power industry are working models of all the important early developments that laid the foundation for electric service; the electric batteries of Volta, the dynamo of Faraday, the steam engine of James Watt, the steam turbine of Parsons, the incandescent lamp of Edison, the Pearl Street Central Station, the Appleton, Wisconsin, hydro-electric station. These show the great beginnings. Models of the very latest development in electrical machinery and equipment are also displayed, models so perfect in detail that the most expert are fascinated by them.

Of still greater interest are the displays of the uses of electricity. "Electricity at Work" is the name that has been given to the Central Station Electrical Exhibit. A gigantic diorama portraying in miniature the production and distribution of electricity is the central feature of this exhibit. It is one of the most fascinating displays of the entire Exposition.

The official guide book of the Fair fittingly refers to electricity as "the servant that has transformed the world." Thomas A. Edison, before his death, could say that "the introduction of electricity in our daily life is the greatest factor in human progress." The truth of these statements is realistically demonstrated by models of modern household interiors, model farms, stores, factories, offices, school rooms, hospital operating rooms, beauty parlors and gardens, showing the most advanced and efficient methods of electric illumination and indicating the many other ways in which electricity is now performing tasks in such places. There are full size rooms and work shops equipped with electrical appliances heretofore unknown by the majority of people. Not only do the models show the latest electrical developments but the latest ideas with respect to the structures themselves and all features therein. In fact, perfection of detail in such respect is the outstanding merit of these exhibits. A striking feature of the exhibit is the modern kitchen where beauty, convenience and efficiency are contrasted with the kitchen of yesterday, faithfully reproduced with its hand pump, its dark corners and surfaces giving the appearance of a dingy and primitive workshop.

Impressive exhibits of the products of numerous manufacturers of all kinds of electrical equipment are also housed in the buildings of the electrical group. In many instances, the displays, which cover every variety of electrical machinery and device for generating, distributing and putting to use electricity represent the most extensive showings yet attempted by manufacturers of electrical equipment.

The long strides of progress recorded in the exhibits of this Exposition have not come without effort. The discoveries of Volta, Faraday, Edison and others were not sufficient of themselves to produce these accomplishments. A long history of grueling, unremitting and intelligent effort by a great body of skilled and devoted workers has been necessary to improve and perfect equipment and methods to overcome or circumvent obstacles to further advancement, to explore and develop new uses for electricity and to reduce costs of rendering service. This effort is still going on. Thousands of workers at the present time are striving to unlock more of the secrets of electricity and to better present accomplishments. The momentum of this vastly mobilized and well sustained effort to advance one of the most useful of arts is a thing of great value, and those who are engaged in it should have the incentive to continued effort that comes from hope of reward and recognition of accomplishment. Not only is it important to the future development of the usefulness of electricity and there-

fore to the well-being of every one that these workers should not relax their efforts to bring about further progress, but it is important that the industry continue to attract young men of ability, capable of carrying on the forward march.

It is well that all of us should have recalled to our minds how we have profited by the electrical developments that have come to us. It is a human characteristic quickly to forget benefits received and this Exposition, devoted to the purpose of showing the achievements of a Century of Progress, serves us all by establishing a record that will not be forgotten.

Twenty-one years ago, at a meeting of the Franklin Institute in Philadelphia, I had occasion to say and it would appear to be more appropriate today than when uttered: "This centenary celebration of gas as an illuminant is a milestone in the progress of the World's great industries. These hundred years have given to mankind many of the most marvelous of its processes and of its inventions. In a gathering of this character we draw upon the past for its history and its lessons. Knowing by these means of the character of the pioneers in industry, and of many of their successors by more intimate association, I believe these men of the present are in a position to contribute much to the solution of problems that today confront the business community; and, furthermore, I believe that many of them are alive to this opportunity for beneficent public service.

"In this time of industrial unrest the business interests of the country should play a conspicuous and helpful part. Commercial honor is not a rarity; the ethics of trade are not mere memories of a glorious past in the life of the nation. Such generalizations are but the familiar stock-in-trade of the professional agitator or self-seeking politician. But business—big business and small business in all its manifold branches—owes its strength and its progress and its permanency to ordered liberty, whose fostering care it can in no wise so well assure, and when assured, repay, as by willing and complete obedience not only to the law of the land but to those higher laws without an observance of which we shall fall far short of our ideals of the true commercial greatness of a mighty people."

In setting apart this day as "Electric Day," the Exposition has paid a tribute to the electrical industry which we deeply appreciate. It is fitting that the first convention of the Edison Electric Institute is being held here amid scenes depicting the landmarks and guide posts of electrical history. With the inspiration derived from these and from other outstanding evidences which the Exposition affords of progress not merely in material things but in the larger things of the spirit, we shall go from here with faith and courage renewed—faith in our country and in our industry, and courage to make that faith effective in works. Then in truth it can be said that we have not only dedicated this Electric Building at the Century of Progress Exposition, but that we have rededicated the industry to the service of the people.

EDITOR'S NOTE: The publishing of Mr. Cortelyou's remarks completes the publication of the addresses and papers given at the first annual convention of the Institute.

"ELECTRICITY AT WORK"

A Souvenir Booklet of the Chicago Exhibit

"Electricity at Work," a handsome souvenir booklet describing the electric light and power industry's exhibit at the Century of Progress Exposition has been produced by the Electrical Central Station Industry Exhibit Committee of which Mr. E. W. Lloyd is Chairman. The booklet is profusely illustrated, in color, and was principally designed as an informative souvenir for those who visited the Central Station's exhibit at the Fair.

The illustration on the cover of this issue of the BULLETIN is taken from the booklet through the courtesy of the Committee.

Distribution of the books hinges on the cooperation of operating companies whose customers visited the exhibit. All visitors to the exhibit are given an opportunity to register on a card provided for that purpose. Copies of the filled-in cards will be sent to power companies ordering quantities of the booklets. It is suggested by the Committee that power companies give out copies of the booklet to their customers who registered at the exhibit and whose names will be furnished by the Committee. A further distribution to executives and employees who are unable to visit the Fair is also suggested.

Several additional uses have been suggested, including that of giving a copy to prospective lighting, commercial and appliance customers, inasmuch as the displays in the exhibit portray the most modern phases of commercial and industrial lighting, electric heat applications, and appliances.

Books are on sale at 25 cents per copy, or $200 per thousand in lots of 1000 and over. Envelopes suitable for enclosure and mailing are $25 per thousand.

Orders may be sent direct to Mr. Jos. W. Hicks, Publicity Director, Byllesby Engineering and Management Corp., 231 South La Salle St., Chicago. Checks should be drawn to the order of Mr., E. W. Lloyd, Chairman of the Electrical Central Station Exhibit Committee, care, Commonwealth Edison Company, 72 West Adams Street, Chicago, Illinois.

Wanted—Murray-Flood Report on Government Owned Utilities

A subscriber is anxious to secure a copy of the Murray-Flood report on "Government Owned and Regulated Utilities in Canada and the United States," published by the National Electric Light Association in 1922. If any reader has a copy which he is willing to dispose of, it will be appreciated if he will communicate with the Editor of the *Bulletin*, 420 Lexington Avenue, New York, N. Y., and so advise, stating the price wanted for the publication.

The Fairy Godmother

"Electricity," says Miss Margaret Prescott Montague in a wonderful article in the September *Atlantic*, "electricity is my fairy godmother."

She was speaking of what electricity has done to brighten the shadows of her night-blindness, to bring her back toward normal hearing, and to supply her with radio. Virginia, all America, might echo her words and apply them to yesterday's great storm.

Few of us realize how dependent we are upon our fairy godmother until, for a moment, she forgets us. Cut off that current and our industry stops. Pull a switch and radio might as well not exist. Flood a generator and every street car stops. Throw down a pole and homes a hundred miles away are instantly cloaked in blackness. Newspapers cease publication. Street cars do not run. Suppers wait uncooked in the suburbs. We are tragically dependent on a luxury our grandfathers never knew.

No wonder the Communists whisper in their councils that if they can seize and hold the power plants, they will have a capitalist society by the throat.—*Richmond, Va., News-Leader.*

ELECTRIC REFRIGERATION BUREAU ANNOUNCES RULES FOR REFRIGERATION WEEK CONTEST

Seven Cash Prizes Total $1,150—Year's Sales Quota Already Obtained, Objective Now Is to Push Total Beyond a Million Units

Cash prizes totalling $1,150 are offered by the Electric Refrigeration Bureau for those local Bureaus or other functioning bodies which shall put on the most effective cooperative refrigeration shows during the Third Annual Electric Refrigeration Week, September 30 to October 7, inclusive. The first award will be $500; second, $250; third, $150; fourth, $100; fifth, $75; sixth, $50, and seventh, $25.

Under the rules of the contest, any local Electric Refrigeration Bureau, Electrical League or Club or similar functioning body, under whose auspices a cooperative electric refrigeration show is carried on during the week of September 30-October 7, is eligible to enter the contest. The show need not be exclusively an electric refrigeration show—it may be an electric appliance exhibit, an electric refrigeration and radio show or a cooking school. By whatever name, the show may be eligible for the contest if electric refrigerators are displayed and if the privilege of exhibition is open to all local dealers or other sales outlets for electric refrigerators.

No show is eligible for the contest unless held between the dates of September 30 and October 7, 1933. It is not necessary that the show be operated continuously between those dates. It is only required that whatever the duration of the show, it be in operation at some time between Sptember 30 and October 7.

In order to give an equal chance to all communities, the results will be compared with population and the number of dealers cooperating with the total number in the territory.

The judges of the contest will be H. M. Faust, New York Manager, The Curtis Publishing Company; Leon H. Curtice, National Electrical Manufacturers Association, and Ralph Neumuller, Manager, The Electrical Association of New York. As soon as possible after November 7th the judges will convene and choose the seven prize winners. In case a tie occurs for any of the seven prizes, duplicate prizes will be awarded.

It is obvious that in a city of a million people it is possible to put on a larger show, to employ more advertising and

(Continued on page 173)

ELECTRIC REFRIGERATION BUREAU
SALES—HOUSEHOLD MODELS ONLY—FIRST SEVEN MONTHS 1933

	Year's Quota	Seven-Months' Quota—74%	Estimated Total Sales	% Quota Realization
New England Division				
Connecticut	15,316	11,334	12,980	114.5
Maine	6,234	4,613	4,175	90.5
Massachusetts	39,027	28,880	39,179	135.6
New Hampshire	4,009	2,967	2,888	97.3
Rhode Island	6,435	4,762	6,949	145.9
Vermont	2,626	1,943	2,060	106.0
Eastern Division				
Delaware	1,607	1,189	1,821	153.1
Maryland & D. C.	15,944	11,799	20,716	175.5
New Jersey	39,021	28,875	35,211	121.9
New York	123,949	91,722	133,620	145.6
Pennsylvania	68,754	50,878	81,421	160.0
East Central Division				
Kentucky	8,934	6,611	12,065	182.4
Ohio	51,228	37,909	53,191	140.3
West Virginia	6,149	4,550	8,770	192.7
Middle West Division				
Iowa	15,232	11,272	11,391	101.0
Kansas	11,343	8,394	10,465	124.6
Missouri	22,078	16,338	31,069	190.1
Nebraska	7,837	5,799	7,142	123.1
Pacific Coast Division				
Arizona	2,295	1,698	2,043	120.3
California	62,735	46,424	45,102	97.1
Nevada	569	421	717	170.3
North West Division				
Idaho	2,582	1,911	1,879	98.3
Montana	2,785	2,061	2,877	139.5
Oregon	7,893	5,841	5,561	95.2
Utah	3,850	2,849	3,759	131.9
Washington	14,270	10,560	8,863	83.9
South Eastern Division				
Alabama	5,470	4,048	7,518	185.7
Florida	7,687	5,688	6,036	106.1
Georgia	6,537	4,837	9,546	197.3
North Carolina	8,601	6,365	11,643	182.9
South Carolina	3,427	2,536	4,263	168.0
Tennessee	7,830	5,794	7,946	137.1
Virginia	8,733	6,462	12,053	186.5
Great Lakes Division				
Illinois	61,455	45,477	55,878	122.8
Indiana	22,386	16,566	18,861	113.8
Michigan	35,191	26,041	24,409	93.7
Wisconsin	20,689	15,310	13,232	86.4
North Central Division				
Minnesota	15,809	11,699	11,478	98.1
North Dakota	1,996	1,477	1,542	104.4
South Dakota	2,558	1,893	2,061	108.8
Rocky Mountain Division				
Colorado	6,745	4,991	7,086	141.9
New Mexico	1,091	808	1,416	175.2
Wyoming	1,045	773	1,172	151.6
Southwestern Division				
Arkansas	3,664	2,712	4,592	169.3
Louisiana	6,525	4,828	5,627	116.5
Mississippi	2,742	2,029	2,369	116.7
Oklahoma	8,346	6,176	11,006	178.2
Texas	20,941	15,496	29,319	189.2
Totals	802,170	593,606	794,967	133.9

Byllesby Prize Paper

INCREASING THE ACCOUNTANT'S USEFULNESS IN THE PUBLIC UTILITY INDUSTRY

By V. THIEMANN

"There are more things in heaven and earth, Horatio,

Than are dreamed of in our philosophy."

There is more, much more, to accounting than keeping financial and statistical records. The accountant may be likened to a historian, who not only recounts occurrences but interprets them, and draws from them inferences and conclusions to guide future leaders. A person who merely puts down events without comment is not a historian, but a reporter.

The Accountant Should Not Only Prepare Statements—

It is not enough to prepare correct accounts, because correct accounts may not be clear to those who use them. The accountant's duty transcends the mere recording of facts, in that the record must be put into graphic and understandable form, filled with the greatest meaning for the non-accountant. It is in this higher interpretation of his functions that the accountant can most increase his helpfulness to the management of his company, to the other departments, to the public, and to his industry.

—But He Should Assist in Their Use

Records, of course, are only a means to an end. The accountant who regards them as an end in themselves, who mechanically performs the functions of posting to ledgers or accumulating data in the sequence called for by some classification, with no further thought to their usefulness or meaning, is doing work which could just as well be performed by a machine. A machine is best fitted for the mechanical performance of duties; the accountant must do something the machine cannot. He must think about his work and its relation to the company operations and to the industry. He should assist in the use as well as the preparation of his records. By increasing the usefulness of his data and statements the accountant increases the usefulness of himself.

This paper won the 1933 First Byllesby prize. Mr. Thiemann is an engineer with the Wisconsin Public Service Corporation, Green Bay, Wis.

To Help Management the Accountant Should—

Utility management must have all pertinent information before making an intelligent decision. Plans for the future of the company and of the industry must be based on past experience projected into the future. Matters of policy cannot be established on thin air, but must have a substantial foundation on fact data, and management expects the accounting department to give it the relevant information it needs.

The contemplation of the purpose and use of his statistics and statements cannot help but broaden the usefulness of the accountant. He will have to ask himself these questions:

"What use is made of this record?"

"What additional information do the executives need that I can furnish?"

—Prepare Appropriate Records—

In answering the first question he will no doubt find that certain subdivisions of accounts are kept which no one uses. In his reply to the second question he may discover that other departments are keeping subsidiary records for their own purposes, in the absence of such information in the accounting department. If the accountants are continually being called upon by other departments for special analyses or detail it may be a sign that their regular reports contain useless or incomplete information; the remedy is to alter the report to fit the requirements.

—Explain Their Meaning—

After the accountant has set up records appropriate to the needs of his associates, and has provided for the orderly, accurate, and intelligent accumulation of the data to go into them, he is charged with the further responsibility to interpret those records. As a short cut to the meaning of many accounting statements and statistics certain ratios, indices, and unit costs are prepared from the underlying data, and changes in these unit figures and ratios are especially important. It is desirable that the accountant understand the basis which these key figures have in the operations of the utility, and what factors influence them.

For example, a change in the kilowatt-hours sold per residential customer may or may not be a cause for concern, depending on the circumstances. A decrease in the kilowatt-hour sales per residential customer may be due to a large number of new customers added to the lines; new customers usually having less electrical consumption at first than after they have become used to the benefits of electricity and have added appliances. In such a case the decrease is not something to worry about as it is to be expected, and probably in the natural course of time the ratio will increase. The usefulness of the accountant's chronicles will not be a maximum unless the accountant is prepared to answer "why?" as well as "what?"

—Extend Them Into the Future—

Whether the preparation of the budgets and forecasts comes under the direct jurisdiction of the accounting department or not, there is no doubt that the accountant can be immensely helpful in their composition. Estimates for tomorrow cannot ignore the results of today; and in his position as historian of the company's fiscal operations the accountant is best able to analyze his records, to find what factors are operating to cause changes in the position of his company, and to evaluate their probable influence in the future.

—And Suggest the Policies His Records Indicate

The accountant is in better position than any one else in the company to act as adviser to management, situated as he is with his fingers on the pulse of the business. It was pointed out that the accountant's duties embrace the analytical as well as the constructive branches of accountancy. The next logi-

cal step is, of course, advisory. He should feel free to suggest the conclusions to which his data lead, and so assist the executive to his decisions. This last step is necessary in order that there may be no unbridged gaps between the assembly of an intelligent record of facts, its assimilation by the managers, its projection into the future, and its influence on the judgment of management. How welcome his advice will be depends largely upon the attitude of the accountant. If it is one of friendly helpfulness there is little doubt that his opinions will be well regarded.

By Understanding the Problems of His Colleagues the Accountant Can—

The accountant should be the most versatile man in the business, because his work touches all departments and summarizes all the functions of the company. He can increase his serviceableness to the rest of the corporation by understanding, in a general way, the duties and problems of the other fellow in order to properly record what is pertinent and to reject irrelevant data. One who is complaisantly ignorant of the technical operations of the various branches of his company cannot keep an adequate chronicle of those operations. To be of greatest help the accountant must set up those data which are most valuable to the other departments, which, of course, presupposes a knowledge of their requirements.

—Lighten Their Work in Giving Him Data—

Many times the operating departments are called upon to furnish statistical information to be included with other figures accumulated by the accounting departments. The accountant can make a more intelligent request for the data he needs and he can lighten the task of preparing them by asking for the information most available. I recall an instance when the "miles of electric circuit" were called for, and since the electric department had been keeping "miles of pole line" and "miles of wire" statistics, the additional request was a puzzler. A decision by the accounting department to use such information as was available saved much labor in this instance. In many cases a slight change in his request may enable the statistician to save other people much time, without rendering his data less valuable.

—Help Them Set Up Their Own Records—

It may be advisable to have the separate departments keep certain data and information, rather than have them maintained by the accountants. However, the acountant's experience should enable him to be helpful in determining what information is needed, in preparing the necessary forms, and in setting up the mechanism for accurately and easily obtaining the information.

A person who is not experienced in the establishment of a record will probably attempt to keep too much material which, while interesting or desirable, is not valuable nor necessary. The accountant, however, understands that the cost of keeping statistics must be balanced against their value. His knowledge of printing or duplicating and his experience in planning his own data sheets will benefit those he assists.

—And Point Out Apparent Deviations from Good Practice—

It was previously pointed out that the accountant should know the meaning of the figures he compiles and submits to management. In reviewing his data and reports, the accountant will no doubt be struck by certain apparent discrepancies. A plant may have suddenly decreased in efficiency—a loss figure may appear abnormal—or an expense may be out of line with previous periods. In such cases the accountant should not be afraid to call for an explanation of something he doesn't understand. He should look upon this request as a duty, a requisite of his job, not as an unwarranted intrusion into the affairs of the other departments. He should couch his questions so that this attitude is shared by those to whom the request is directed.

—Which Will Add to His Knowledge of the Company

There are several good results which may ensue from this policy of asking questions, and one of them would be that the attention of the operating department is focused on the discrepancy, so that if a change in the operations is indicated, it will be undertaken. In any event, the accountant will add to his knowledge of the business, which will make him better able to give management the explanations as well as the data it requires.

The Accountant Can Coordinate the Specialized Work of the Various Departments—

One disadvantage of specialization is that each department looks to its own duties and interests, and certain fundamental aspects of our problems may drop between departments and be neglected. Someone should see that the best interests of the company as a whole are safeguarded, and the accounting department, being in intimate contact with all phases of the utility, can best coordinate the work, making sure that all the loose ends are gathered up.

—Paying Special Attention to Economics—

In the many projects which the utility undertakes there must be a judgment, explicit or implied, that the value of the work will exceed its cost—the economics of the plan must be considered. Accountants can increase their usefulness by doubling as economists, to see that the revenue or saving is not extravagantly estimated, and that all elements of cost applicable to the case are given proper weight. Sometimes cost means "out-of-pocket" expenditure; other times it should include much more than that; the approach to any particular problem must be dictated by the economics of the situation. We can't put prospective revenue into the bank, so all optimism must be removed from the revenue estimates.

—Weighing Cost With Value on All Projects—

There is a class of projects in which it is difficult to compare the cost of the job with the value, and this type includes those undertaken to improve service. The value is a sort of "nuisance value" and is difficult to estimate; this difficulty, however, should not deter the accountant from making an evaluation of the worth of the project after taking into consideration all the factors. In the matter of improving voltage conditions, it is sometimes urged that an increase in voltage will cause an almost proportional increase in revenue; however, as a recent article* pointed out, this is not always true.

Space will not permit mention of all the factors to be examined in the projects which are brought up, and each case must be examined on its own merits. It is not the duty of the accountant to set up standards of service or to master the technical problems involved in maintaining those standards; but the accountant should insist that such an evaluation of each project is made. He should review the economic soundness of the arguments for the proposal and weigh the worth with the cost, to the end that we may not pay too dearly for our whistle.

* "Revenue Loss From Undervoltage Less Than Believed"—by Merrill DeMerit. *Electrical World*—December 24, 1932, page 856.

—And Looking After the Legal and Regulatory Phases of Our Problems

Besides economics, there are other fields of usefulness for the accountant in coordinating the functions of the various departments of the company. As he checks its operations and projects to see that no details are overlooked and each job is complete and whole he will find himself looking after some of the legal and regulatory aspects of the situations involved. We can't consult the legal staff on every minor point of law which comes up, and even a cursory knowledge on the part of the accountant will enable him to enhance his usefulness. If he knows what permits are required from the authorities, or what property rights of others are involved, for the different projects of the utility, he will be able to expedite its undertakings and probably avoid later recriminations or legal entanglements.

The Accountant's Duty to the Public Includes—

The employees of the accounting department are the main, and many times the only contact which the customers have with the utility company, and as far as this large part of the public is concerned their attitude and ability is that of the whole company. A utility needs friends just as much as any individual, and the cashiers, collectors, meter readers, and other contact employees of the accounting department are in a position to make and keep friends for the company.

—Justifying the Utility to the Customer—

It requires more than courtesy and shined shoes to satisfy a customer who believes he has a complaint. The accounting employee, in order to realize his maximum usefulness must be familiar enough with the rate structure, the operations and service standards of the company, and the forces which affect the use of service to demonstrate that we are both fair and industrious, and that the customers are getting what they pay for.

—And His Industry to the Public

In justifying the utility to the public, comparisons with other utilities, both publicly and privately owned, will have to be made. To make such comparisons the accountant will have to display all the requisites previously described, such as his ability to interpret the statistics of the industry; his knowledge of economics, laws, taxes, and regulation, and of service and rates.

He Should Also Take Part in Association Activities

After the accountant has discovered ways to improve his usefulness he can magnify the scope of such means as he has found by utilizing the leverage of the written and spoken word. The industry will profit if the accountant will give it the benefit of his improved methods of service through his attendance at meetings and conventions and through the preparation of articles and papers. The well-equipped accountant should be articulate so that he can express his ideas both in informal conferences or in formal convention. He should also be able to accompany his fiscal and statistical reports with concise, well-written explanations and recommendations.

In summary then, let me repeat that the public utility accountant can find many ways to increase his usefulness. He will add to his own helpfulness by increasing the usefulness of his reports to those who use them, by interpreting and explaining his data and projecting them into the future. He can advise management and show what course is indicated by his figures, and can assist in the preparation of forms and records.

To promote the best interests of the company as a whole the accountant will see that the specialized work of the different departments is unified and that no aspects of our problems are neglected, giving special attention to the economic, legal, and regulatory phases. Because the accounting department represents the company to the average customer its members should create confidence in the utility and the high value of its service. The accountant should be able to reply to unjustifiable attacks on his utility or the industry by analyzing and pointing out the relevant factors in the comparison of one concern with another. Finally, the accountant can increase the influence of his ideas by extending them to the fellow members of his industry through the channels of meetings and papers of the industry.

A knowledge of accountancy is not the end, but the beginning, of the accountant's equipment. If he interests himself solely in the preparation of accounts he will be neglecting many opportunities to extend his helpfulness, and, after all, we benefit ourselves only in the same degree as we assist others. There is more, much more, to accounting than keeping financial and statistical records. *"There are more things in heaven and earth, Horatio,*

Than are dreamed of in our philosophy."

ELECTRIC REFRIGERATION

(*Continued from page* 170)

to provide more special features than can be done in a town of 5,000 population. To provide equal opportunity for all, the contest judges will be provided with the last U. S. Census figures of population for each city or town from which a contest entry is received and the results will be weighed accordingly.

The judges will not consider that the show with the largest attendance necessarily stands in first place on that point. The town with the best record on that point will be the one which has the highest percentage of attendance in proportion to its population. Similarly, not the total number of prospects obtained but the total in proportion to population will be a criterion—and not the total sales, but the total proportionate sales. Throughout, the judges will base their final decisions on what was done and what was accomplished as compared with the scope of the local opportunity.

All entries in the contest must be received at the Electric Refrigeration Bureau, 420 Lexington Avenue, New York City, on or before November 7, 1933.

July Sales 100,000 Over Last Year

Sales of household electric refrigerators continue at an unprecedented rate. The total for July was 128,217 units, compared to 28,785 units sold in July, 1932, and 101,974 in the same month of 1931, the record year.

The July figure brought the total sales for the first seven months of the year to 794,976 units, as against the Bureau's quota of 800,000 for the entire year. With this quota already obtained, the Bureau's present objective is to push the year's total as far above a million units as possible.

At the end of July thirty-nine states had sold more than their seven months' quotas and twenty-three of these had exceeded their quotas for the entire year. New York led all other States in July sales with 25,126 units, which figure represents nearly 20 per cent of the month's total for the entire country.

1924-1927 N E L A Bulletins

A subscriber has bound volumes of the *N E L A Bulletin* for 1924 and 1925, unbound copies for 1926, and the issues of January, February and March, 1927, which he desires to sell. The editor of the *E. E. I. Bulletin* will be glad to forward any inquiries regarding these numbers.

POWER SYSTEM INTERCONNECTIONS*

This report is intended as a guide for executives, engineers and operators interested in the overall benefits of power system interconnections. It presents the more important factors to be considered, in outline form for the sake of brevity and completeness. A bibliography is included for those interested in a further pursuit of the subject. In addition, appendices are added, elaborating on the problems of management, contracts and operating, about which little is available in the references.

Power Systems Engineering endeavors to provide an electric supply adequate in quantity, quality and reliability at a minimum cost to meet customers' requirements and commensurate with a reasonable return to the men and money employed in the service.

Interconnections—the tying together of power sources or transmission facilities—are often an important factor in accomplishing this objective.

In studying this phase of system planning there are several subjects to be given careful consideration. The more important of these are:

I. The possible gains by interconnection.
II. The physical problems involved.
III. The contractual, management, and operating problems involved.
IV. Restrictive laws and taxation.

Under these general subjects, a number of points may be outlined, as follows:

I. The Possible Gains By Interconnection

A. Reduction in plant investment by:

1. Staggering power house construction and thus making it possible to install larger units and units which are more economical both in efficiency and in installed cost.
2. Constructing jointly-owned power houses.
3. Making use of existing over-capacity in part of the system.
4. Developing hydro-stations that are justified by the size of the system if interconnected.
5. Constructing hydro plants in conjunction with water works, navigation, irrigation, etc., the combination of which justifies the total development.
6. Installing by-product steam plants.
7. Utilizing load diversity and peak diversity.
8. Reducing the total standby reserves.

B. Improvement in reliability of service by:

1. Providing additional sources of power supply to carry the individual load centers.
2. Making available additional generating equipment in case of emergency.

C. Reduction in net operating expenses by:

1. Making maximum use of surplus hydro.
2. Making maximum use of the diversity of flow in the different rivers.
3. Absorbing peaks and emergencies on hydro plants.
4. Making maximum use of hydro storage in giving steam plants base load and reducing steam standby.
5. Coordinating most economically the use of all steam and hydro equipment.
6. Making maximum use of by-product power.

II. The Physical Problems Involved

A. Adaptation of existing plant:

1. A survey should be made of existing switches, lines, and substations to see that they are of ample capacity to carry the probable loads under the conditions to be imposed by interconnection, and that the switches are of sufficient rupturing capacity.
2. Existing relaying and metering require coordination with the interconnected system.

B. Additional facilities required:

1. Tap changing transformers or regulators with a proper range to satisfactorily control the reactive flow and to match voltages may have to be provided.
2. Difference in frequency may require frequency changers.
3. If the interconnection closes a loop, load control equipment may be required. The phase angle must be checked.
4. Adequate metering is essential. Local operators must be supplied with complete knowledge of operating conditions and it is desirable to supply the dispatchers with direct indications of tie-line loading through remote metering. Billing meters should be of a high degree of accuracy and should be easy to check and adjust.
5. Proper communication facilities are a primary requisite. Leased lines, toll service, local service, private lines, carrier and wireless all have their places.
6. Relaying must be provided to isolate a section in trouble and to separate the systems without detrimental effects in case of a bad surge or excessive overloads without being affected by ordinary load swings.

C. In selecting voltages, size and type of lines and equipment, and right-of-way, the ultimate development of the system as well as the needs of the individual interconnecting companies should be kept in mind.

III. The Contractual, Management and Operating Problems Involved

A. Contracts: Care should be taken in drawing interconnection contracts to see that the legal requirements are properly covered in a clear, understandable manner, and that economic operation will not be hampered by impossible or restrictive clauses. (See Appendix A for further details.)

B. Management: The type of organization, the authority and responsibility to be delegated, together with selection of the proper personnel, should all be given careful consideration. (See Appendix B for further details.)

C. Operating: To meet the problems incident to interconnection, special knowledge and training are required. These problems may be roughly divided into two groups, equipment control and operating accounting, both of which are important in obtaining the desired results. (See Appendix C for further details.)

IV. Restrictive Laws and Taxation

Not only the present restrictive laws, but the probable trend of laws, have a great bearing on interconnections. Special taxes have a definite effect on operation and construction. Such taxes as are now being imposed in certain states are definitely restricting development.

Appendix "A"

CONTRACTS

There are certain cases where interconnection contracts are not needed. As a matter of fact, there are several interconnections that are giving maximum service and savings without a contract. In other cases, however, there are certain legal requirements such as return on investment, amortizing, operating expenses, maintenance and final disposition of the property that make a contract necessary. It may also seem advisable to include general operating methods and means of adjusting differences of opinion. *However, if it is the intent of the interconnecting parties to make most effective use of the interconnections, the contract should be so drawn that economics and not the contract will govern operation.* Experience has shown that maximum power flow and savings are obtained when such transfers are based solely on day-to-day operating conditions. This requires that operation be considered as if under a single ownership. To approach this, the operating department must be allowed the equivalent freedom of action.

The alternative to interconnection would probably be the building of additional plant facilities on the part of one or more of the parties involved, and it is a comparatively simple matter to figure out an annual saving in fixed charges and to divide that saving equitably between the interconnecting parties. The payment may be arranged either as an annual lump sum or on a monthly basis if that is preferred. Since maintenance and operation expenses (other than fuel) are independent of the kilowatt-hours transferred, they can be readily included in the fixed charges. This arrangement also tends to simplify operating procedure.

Power factor clauses are closely associated with demand charges. While it is, of course, necessary from the point of view of voltage regulation to control the flow of reactive kv-a., contract restrictions on this flow should be kept to a minimum since in interconnected systems of more than two companies system conditions and not the individual dispatcher often control interconnection

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* A report of the former Power Systems Engineering Committee. National Engineering Section, N.E.L.A., E. A. Hester, *Chairman*. Prepared by the System Operating Group, C. W. Mayott, *Chairman*.

loadings. This, as in the matter of demands, is a subject of economy and engineering rather than one of law, and where practicable had better be left out of the contract except for very broad limitations.

Having disposed of the fixed charges in this manner, the kilowatt-hours transferred can be billed in a manner to distribute the savings in increment costs between the two parties. This is what is known as the economy basis of operation and is equivalent to the manner in which such an interconnection should be handled if both companies were operated by the same organization.

There should be some method of checking the capacity and operating reserves of the individual company to see that no company is shirking its obligations, either deliberately or unconsciously.

There is always the possibility of disagreement. To cover such cases an arbitration clause is helpful.

Appendix "B"
MANAGEMENT

The problems of management of the interconnections are those of coordinating the operations of the various independent groups so that they can and will function as a unit. The approach to this problem must be from a very different angle than that used in an independent company. Coordination and cooperation, not compulsion, must be the basis of such an organization. The delegation of authority should be accompanied by the corresponding placement of responsibility.

Methods and personnel that appear to be satisfactory in the local company may be far from satisfactory when applied to the interconnection. With the interconnections much responsibility previously reposing in the management of the individual companies must be delegated to their operating departments. This increases the importance of the proper training and proper personality on the part of the operating forces.

It is very desirable to have the responsibility and authority for interconnected operation placed upon a definite executive in each of the companies involved. Such an executive should have the authority to make the necessary decisions, should have an operating point of view, but should not be directly responsible for the operation of a particular plant. A committee or board of such men would supervise the operation. The technique of such supervision would depend upon the particular case. It might be through the individual companies, or through one of them (both of which may bring up some delicate point of responsibility and discipline), or an entirely separate control organization may be advisable.

The operating committee should coordinate the engineering, accounting, relaying, metering and operation. They should also be responsible for the equitable division of the benefits incurred.

It is well to realize that rules of procedure are of little value without the will to make the interconnection work.

Appendix "C"
OPERATING

The operating problems may be divided into two classes, both of which are equally important. The first is that of equipment control and the second that of operating-accounting.

The problem "Equipment Control" which is generally considered to be the main function of operating, is that of maintaining the proper and continuous generation and delivery of power. The interconnected operating forces should make the most effective use of all the equipment available. Sufficient reserves should be so distributed as to adequately protect against probable equipment failure. Reasonably close frequency and time regulation must be maintained. Detrimental fluctuation in tie-line loading must be kept at a minimum. Power should be generated at such point as to obtain the greatest over-all economy with due allowance for proper safety of operation and for limitations of equipment. The control of these factors can only be obtained by cooperative agreement. They are often beyond the control of individual interconnected companies.

Operating-accounting, which requires a knowledge of engineering, operating, and accounting, has an importance often disregarded in the past.

Maximum economical transfer and correct accounting are dependent upon accurate cost and operating data. These are most satisfactorily collected and handled through engineers in the operating department.

It is difficult to maintain the proper and desired transfer between companies unless the charges and credits are in accordance with the facts. The incremental basis of calculation is the most accurate and has worked out the best. A proper set-up to handle this phase of the subject and proper correlations with all departments are very essential.

With the interconnection an educational plan for the operators is even more essential than without interconnection. This plan need not be elaborate, but should be continuous and under the supervision of someone with the proper training and experience. It should include get-togethers of the men who have contact with each other.

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ELECTRICAL EQUIPMENT COMMITTEE

(*Continued from page* 166)

B—*Station and Substation Equipment*	*Sponsor*
1. Insulating Oil Fire Hazards	H. W. Eales
2. Oil Circuit Breaker Rating	Geo. Sutherland
3. Rectifier Developments	W. F. Sims
4. Network Vault Equipment (Joint with Trans. and Distribution Committee)	Geo. Sutherland
5. Electronic Developments	H. W. Eales
6. Noise Mitigation	H. W. Eales
7. Foreign Practice Contacts	W. F. Sims

No formal subject committees have been formed in this division. For the present the subjects will be taken care of by individuals and Joint Industry or A.S.A. Sectional Committee representatives.

C—*System Equipment Engineering and Operation*	*Sponsors*
1. Service Protection	Philip Sporn
2. System Grounding	S. M. Dean
3. Insulation Co-ordination	J. A. Johnson
4. Load and Frequency Control	Philip Sporn
5. Operating Experience with Reclosing Circuit Breakers	E. S. Fields
6. Apparatus and System Troubles	A. H. Sweetnam

One subject committee has been formed under this group, namely on "Wave Shape" sponsored by Mr. Sporn.

On account of the reduced personnel of the Committee as compared to the N.E.L.A. Committees which it supersedes, thus greatly reducing the field within the immediate purview of the members, it is necessary, if the committee is to serve the industry efficiently, that it be advised of developments of interest to it wherever and whenever they occur. Those having information or recommendations to convey may do so either through the sponsor concerned or directly to the Chairman or Secretary.

J. Allen Johnson, *Chairman.*
J. O'R. Coleman, *Secretary.*

THE HARNESSED LIGHTNING

An editorial from the Washington (D. C.) Evening Star

"Yesterday's storm brought to the philosopher's attention a curious circumstance of modern life. Ordinarily, few would think of it, but the great elemental disturbance which swept the eastern section of the United States momentarily gave it prominence. It may be accepted as a measuring stick for the progress which mankind has made in the past two or three generations. Mysterious in its origin and character, not yet analyzed or fully understood by science, it is the harnessed lightning, the power called electricity; and the degree of its importance in the economy of the people was rendered abundantly manifest by the incident of its temporary withdrawal.

"Thousands of homes in the vicinity of Washington last evening were without light. Their owners, relying upon electricity for illumination, long ago dispensed with ordinary oil lamps. In the emergency they perforce fell back upon candles, but the expedient was unsatisfactory. They realized, possibly for the first time in years, their dependence upon the distant power plant. and the experience was revealing.

"Their electric refrigerators also had suspended business, and there was no ice to be had for the taking. A small deficiency this might seem, but strangely enough a remarkable demand for the little frozen cubes from the convenient tray developed in tantalizing proportions. The glass of milk or ginger ale which otherwise would have been a mid-evening refreshment was an insipid affair.

"The radio likewise was out of commission. Any other time it might not have been missed, but perhaps just because it was silent, it was wanted. There might have been interesting news flashes to be heard, and the suggestion.

(*Continued on page* 196)

HYDROGEN-COOLED AND OUTDOOR AIR-COOLED ROTATING MACHINERY*

This report deals with the recent installations of hydrogen-cooled and outdoor air-cooled rotating machines.

The relative advantages and disadvantages of hydrogen cooling are discussed in some detail and data are given on design of various installations and on the operating experience with such machines.

In recent years much energy has been directed towards the reduction of investment costs. In stations and substations studies have been made to determine economic size of apparatus, to simplify layout, to reduce over-all costs, and to derive the most economical means of fitting the station into the general system design. One phase of this effort to reduce investment costs has been the installation of switching equipment and machinery out of doors. For many years some of the static equipment has been placed out of doors because with such apparatus as transformers, the necessary changes in design required for outdoor installations have been rather simple. Recently, certain rotating machines have been designed so as to make them suitable for outdoor use. Among the first machines to be so installed were synchronous condensers. There have been also some outdoor installations of frequency changers and hydro-electric generators. At the present time, even the installation of outdoor steam turbo-generators is being considered.

In this report the existing installations of outdoor rotating machines have been analyzed and various engineering features discussed. The designs used for hydrogen cooling or for a closed circuit air ventilation were found to be readily adaptable to outdoor installations.

TYPICAL INSTALLATIONS

The outdoor installations of rotating machinery which have been analyzed in this report may be classified as follows:

Synchronous Condensers

Nine hydrogen-cooled outdoor installations and one indoor hydrogen-cooled installation are reported in this country, the machines ranging from 12,500 kv-a to 30,000 kv-a in capacity.

Six air-cooled outdoor installations comprising 12 synchronous condensers ranging from 7500 kv-a to 30,000 kv-a in capacity are reported in this country and Canada.

Frequency Converters

Only one outdoor frequency changer installation consisting of two air-cooled 21,000 kv-a units is in operation in this country.

Hydro-Electric Generators

While not covered in detail in this report, mention has been made of six outdoor hydro-electric generator installations comprising 14 units ranging from 250 kv-a to 25,000 kv-a in capacity.

Turbo-Generators

According to manufacturers' statements, the outdoor installation of turbo-generators is feasible if demanded. However, no specific installations have as yet been made.

HYDROGEN-COOLED MACHINES

Electrical manufacturers are constantly striving to improve the efficiencies of their machines by using better magnetic steel, changing machine proportions, transposing windings, perfecting insulation, etc. However, these items have been developed to such an extent that any further improvements give only very small increase in the efficiency of the machine. Recently, a more revolutionary design feature has been developed, namely, the use of hydrogen as the cooling medium, which promises much in the decrease of operating costs.

In the past few years several installations of hydrogen-cooled synchronous condensers have been made throughout the country, and other installations are being made at the present time.

Since a hydrogen-cooled machine must of necessity be fully inclosed, this type of machine lends itself very well to outdoor operation, and most of the installations have been of this type.

Advantages of Hydrogen Cooling

1. Windage losses are reduced to about 1/14 as compared with losses in air.

* A report of the former Electrical Apparatus Committee, Engineering National Section, N.E.L.A., W. F. Sims, *Chairman*. Prepared by the Electrical Machinery Subcommittee, L. G. Smith, *Chairman*.

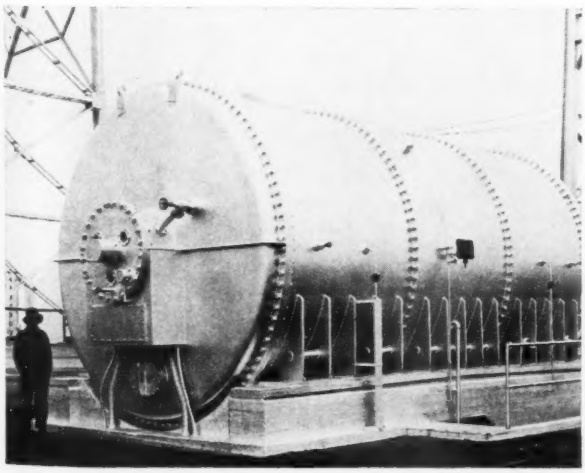


Fig. 1. View of 50,000 kv-a outdoor hydrogen-cooled synchronous condenser installation. Company No. 4.

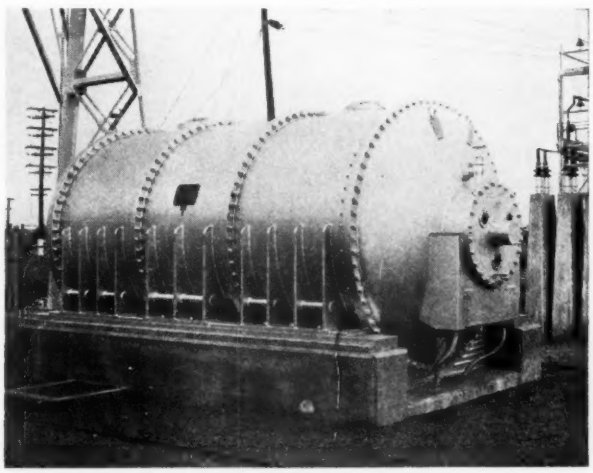


Fig. 2. Installation of 20,000 kv-a outdoor hydrogen-cooled synchronous condenser. Company No. 3.

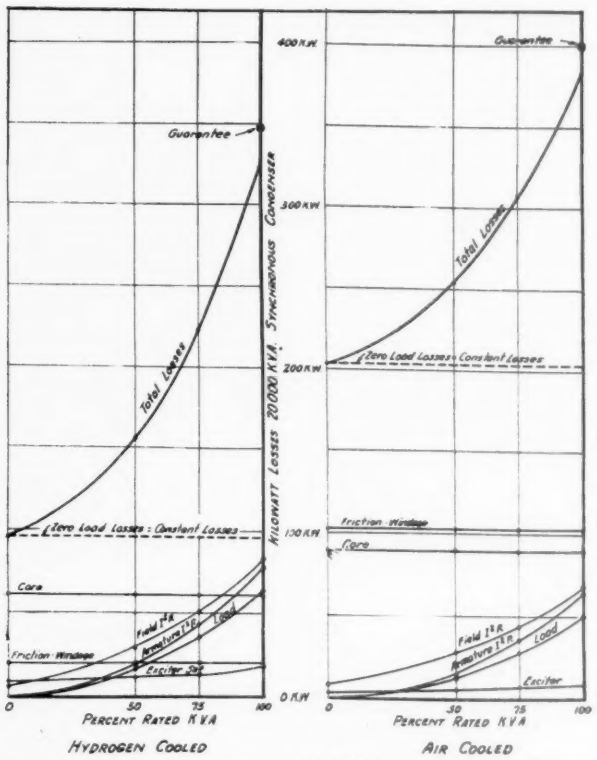


Fig. 3. Comparative losses of 20,000 kv-a installation shown in Fig. 2 and a standard air-cooled machine. Company No. 3.

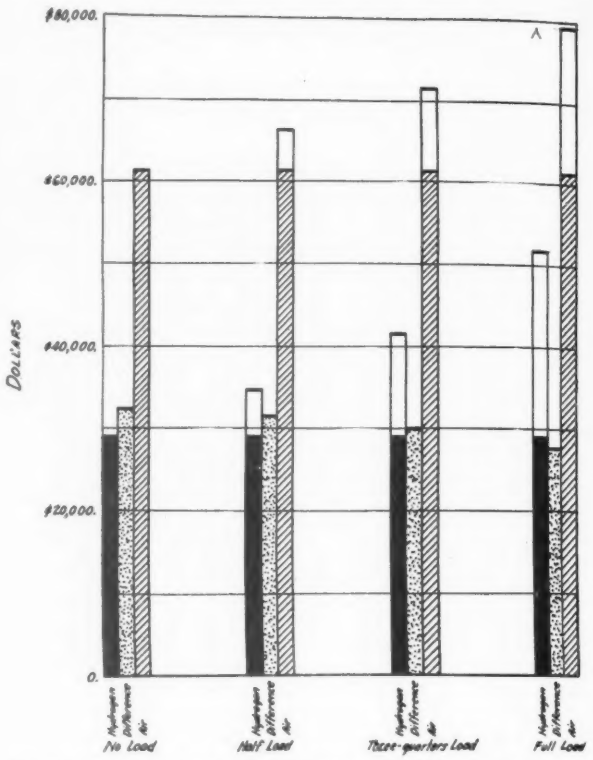


Fig. 4. Comparative value of losses of 20,000 kv-a hydrogen-cooled condenser versus an air-cooled machine. Comparison determined for installation shown in Fig. 2. Company No. 3.

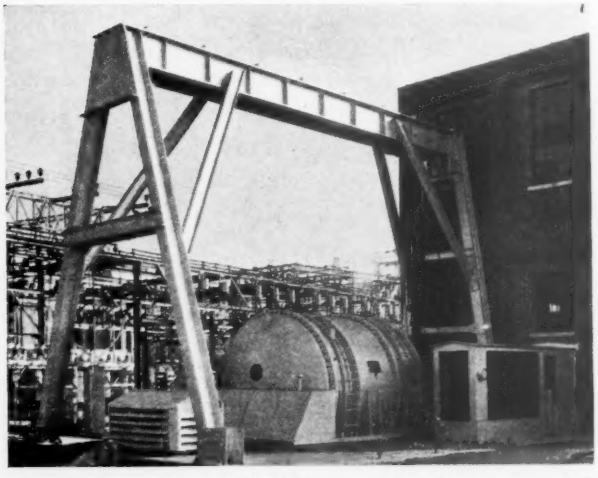


Fig. 5. Installation of 20,000 kv-a outdoor hydrogen-cooled synchronous condenser. Company No. 5.

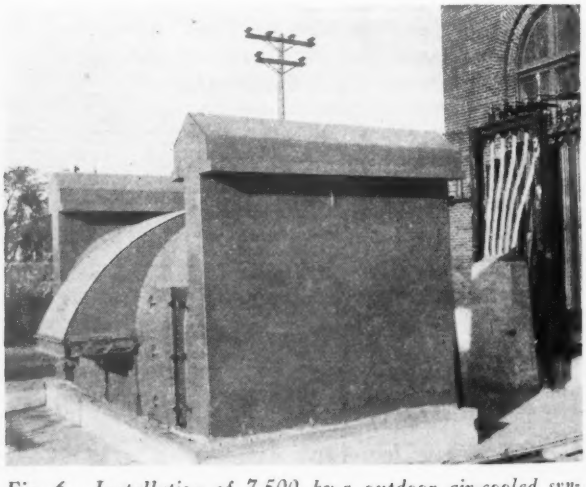


Fig. 6. Installation of 7,500 kv-a outdoor air-cooled synchronous condenser. Company No. 10.

2. Because hydrogen has the heat conductivity seven times that of air, the heat from the windings, bearings and other hot parts will be carried away much more rapidly. This allows an increase of about 25 per cent in rating with the same temperature rise.

3. Since the machine is designed to be gas-tight, it can be considered water-tight and be placed outdoors.

4. Complete inclosure prevents the entrance of dirt and moisture into the windings, which increases the insulation life materially, and also reduces inspection and maintenance.

5. The damaging effect of corona upon the insulation is removed in the hydrogen atmosphere. In certain residential sections noise reduction becomes of increasing importance. With hydrogen-cooled machines there is only a slight hum comparable to that of a transformer of equal rating.

Disadvantages of Hydrogen Cooling

1. Because of the increased amount of equipment and auxiliaries, it would appear that reliability and safety of hydrogen installations were questionable. From the information received so far, it can be seen that there have been some

initial difficulties due to hydrogen leakage in the piping and in the seal between the main shell and collector ring chamber, and in the cooling coils. However, in most cases, after some experience the manufacturers have remedied these early troubles and the indications are that similar difficulties will be prevented in the future.

2. Due to explosive nature of the mixture of hydrogen and air, some anxiety was felt as to the safety of machines cooled by this medium. A test was made on a 20,000 kv-a machine which indicated the strength of a typical construction. The empty shell was filled with the most explosive mixture of air and hydrogen possible, the machine was then sealed and the mixture exploded with a spark plug. There was no damage to the shell and if the rotor and windings had been in place, the pressure inside the shell would have been reduced to about half of the observed value.

AUXILIARY EQUIPMENT

The additional auxiliary equipment required for the operation of a hydrogen-cooled machine consists of the following:

1. *Hydrogen Supply Cylinders*—Usually two cylinders are connected to the supply line at a time, one of them being a reserve. These cylinders are returnable when the gas in exhausted. They contain about 225 cu. ft. of hydrogen compressed into 1.6 cu. ft. of space at a pressure of about 2000 lb. per sq. in. By means of a reducer valve on top of the cylinder this pressure is reduced to 25-30 lb. in the supply line to the gas regulating panel which maintains a pressure of about ¾ to 1½ lb. per sq. in. in the shell of the machine.

2. *Gas Regulating Panel*—On this panel are mounted a gas drying device, a pressure control regulator, a gas purity indicating device, and thermometers indicating temperature of bearings and of the gas as it enters and leaves the cooling coils.

3. *Water Circulating Pumps*—There are usually two of these pumps, one being a reserve, for circulating the cooling water through the cooling coils. One cooler is usually located on each end of the shell.

4. *Cooling Water*—If a cheap supply is not available, then a supply pond or a cooling tower with the additional pumping equipment is necessary.

ADVANTAGES OF OUTDOOR INSTALLATIONS

The chief advantage of the outdoor installation consists of the elimination of

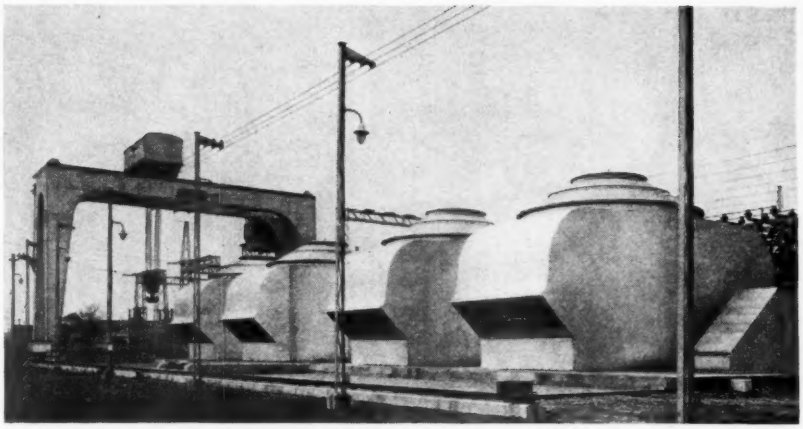


Fig. 7. Installation of four 25,000 kv-a outdoor air-cooled synchronous condensers. Company No. 11.

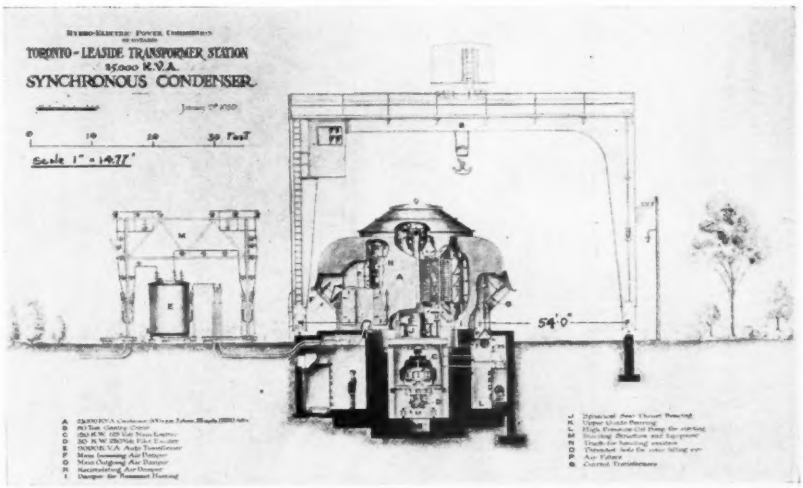


Fig. 8. Details of 25,000 kv-a machines shown in Fig. 7. Company No. 11.

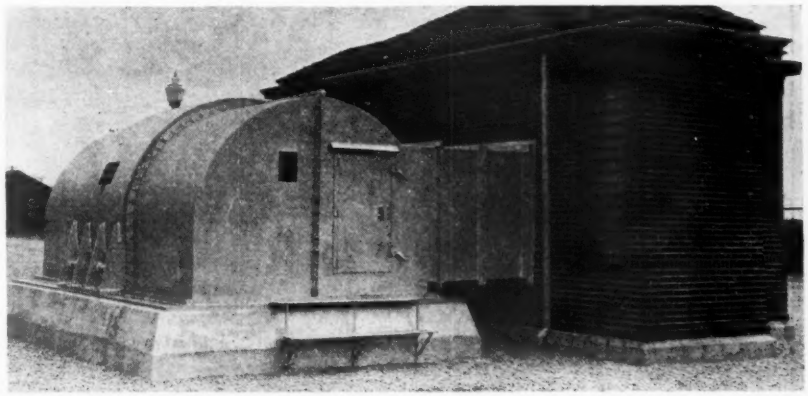


Fig. 9. Installation of 15,000 kv-a air-cooled outdoor synchronous condenser. Company No. 13.

TABLE NO. 1. INSTALLATIONS OF HYDROGEN-COOLED SYNCHRONOUS CONDENSERS

Summary of data and comments on the design and operation of the machines as reported by operating companies, the companies being designated by numbers.

Operating Number	Location of Installation	Type and Date of Installation	Rating and Voltage	R.P.M.	Manufacturer	Cooling System	Operating Pressure of Hydrogen in Lbs./sq. inch.	Motor Coolers for Hydrogen Inside or Outside of Machine Shell	Reason for Selection of Hydrogen Cooling	Trouble Experienced	Description of Installation and Remarks.	
											Nothing unusual	About the same
1.	Rhode Island	Outdoor 1928	12,500 kv-a. 13,200 v.	720	G.E. Co.	Hydrogen	0.90-1.07	Inside	For experimental data	Nothing unusual		Condenser, all switching equipment, buses and starting transformers, are installed adjacent to station building. No crane provided. Installation is not believed to be typical for voltage 70,000 kv-a. Overall cost about equal to indoor installation.
2.	Illinois	Outdoor 1930	15,000 kv-a. 18,000 v.	900	G.E.Co.	"	0.75-1.25	Inside	Economy of operation. Minimum noise.	One leakage around sealing ring. Manufacturer installed another type of seal.	About $600 per year to cover operation of oil pumps and hydrogen replacement.	Starting transformer is outdoors, cable connected. Switchgear is indoor metal-clad Reyrolle type. Hydrogen control equipment and part of machine oil pumps are located in basement of switchboard room. Remainder of oil pumps, with the electrical control panels are a part of main switchboard in substation. Exciter is in substation. No crane provided. The higher cost of installation was justified by lower operating costs. Costs are the maximum saving obtainable in the cost of a building and crane. From the erection point of view it was contended that the expense of hydrogen leakage ($150 per year) and maintenance of pumps ($350 per year).
3.	California	Outdoor 1931	20,000 kv-a. 12,500 v.	900	G.E. Co.	"	0.50-1.50	Inside	Desire for experience. Lower installation cost. Elimination of cost of installation.	About 10% extra labor required. Will install spare machine gas refill cost about $75, plus cost of hydrogen gas for 5 hrs.	If necessary to operate machine gas will be removed during installation.	Hydrogen control equipment, exciter set and electrical controls are located in substation switchboard room. Main buses and transformers are outdoors. A 10-ton gantry crane spans the condenser. Total cost about the same as for indoor installation. Estimated that a suitable building would have cost $60,000. Hydrogen cooling reduced losses by 15%. Experience has been very favorable, similar installations would be considered.
4.	California	Outdoor 1931	20,000 kv-a. 13,200 v.	600	G.E. Co.	"	0.14	Inside	Desire for experience. Lower installation cost. Elimination of cost for outdoor installation.	None of any consequence.	About the same.	Steel switching structure and transformer bank outdoors. The machine is connected to hydrogen control equipment and oil pumps. An adjoining switchboard house contains the electrical control panels. The remainder of the machine is in a regular indoor substation building on the opposite side of the crane runway from the condenser. Experience has been very favorable. While the gantry crane itself cost $20,000 more than ordinary indoor condenser, a suitable building would have cost $60,000. Hydrogen cooling reduced losses by 15%. Experience has been very favorable, similar installations would be considered.
4-a.	California	Outdoor 1930	15,000 kv-a. 11,000 v.	Westing-house		"	0.07-0.14	Inside	Same as (4)	Defective water coils. Replaced by manufacturer.	" " "	Steel switching structure is outdoors adjacent to a substation building. Two hand-power travel hoists on 42 ft. structure span the machine.
5.	West Virginia	Outdoor 1926	20,000 kv-a. 11,500 v.	900	G.E. Co.	"	0.53	Inside (spray pond.)	For obtaining data on minimum losses and maintenance.	Slight leakage in collector compartment seal.	" " "	Outdoor steel structure contains switching equipment. A hand operated chain hoist is provided for handling parts. All piping, including hydrogen control equipment, water mains and piping. The water is pumped from spray pond 400 feet away. This was a joint experimental installation and the expense of the machine alone was not justified the installation on because of minimum losses and maintenance.
6.	West Virginia	Outdoor 1931	15,000 kv-a. 26,000 v.	900	G.E. Co.	"	0.75	Inside (cooling tower)	Same as (5)	None	" " "	Installation is similar to that above, except that a cooling tower is used instead of a spray pond.
7.	Indiana	Outdoor 1931	20,000 kv-a. 11,500 v.	1200	G.E. Co.	"	0.75	Outside (spray pond)	Same as (5)	Vibration and high gas leakage.	" " "	Spray pond is used for cooling water. No other data.
8.	Michigan	Outdoor 1931	15,000 kv-a. 11,500 v.	900	Westing-house	"	0.53	Outside (spray pond)	Same as (5)	High gas leakage.	" " "	Spray pond is used for cooling water. No other data.
9.	New Jersey	Indoor 1930	15,000 kv-a. 4,150 v.	900	G.E. Co.	"	0.75	Outside	Same as (5) and noise reduction	Oil pipe leaks.	" " "	The indoor hydrogen cooled machine was used as means of noise reduction. The expense of installation was justified.

building costs and in some cases omission of an overhead crane. These appear to have been the deciding factors in the majority of such installations. In other installations the desire of the manufacturer and operating companies to obtain definite operating data was the main reason. In the latter cases the results obtained have justified the decision. Outdoor installations have been subjected to severe climatic conditions of rain, fog, sleet, and temperature ranging from 100 deg. F. to 26 deg. F. below zero, without any effect on reliability of operation. This experience is of vital importance to the operating company when considering such an installation.

DESIGN OF INSTALLATIONS

In comparing the costs of outdoor and indoor installations, each individual case has to be considered separately. The cost will depend upon space available for the machine in an existing building and upon whether or not it is intended to provide a crane for the machine. Some of the companies have provided rather elaborate crane facilities for the outdoor installations but stated that they would also have provided cranes for indoor installations. Others have made no such provision, assuming that the few occasions when heavy repairs might be necessary could be handled more economically by erecting special rigging for the occasion. One company that provided crane facilities on one of its earlier condenser installations states that this would not be considered on future installations. Another company in the Middle West had a completely assembled 15,000 kv-a synchronous condenser shipped from the eastern factory and the erection on the prepared foundation was done by contract. The cost of such labor and its availability, of course, depend upon the location and this determines to a great extent whether an outdoor crane will be justified.

Mention is made in this report of a frequency converter installation consisting of two 21,000 kv-a units located outdoors under a close-fitting sheet-steel housing for each of the two units, a portion of which is removable for major repairs. No crane is provided although the use of a locomotive crane is available from the adjacent railroad siding. The housings are of sufficient size to provide a passage on all sides of the machine. In this case it was realized that the maximum saving obtainable was in the cost of a building and crane. From the erection point of view it was contended that the

normal type of crane gives a comparatively small saving on the total erection costs. Under operating conditions any part of the stator and rotor can be repaired by sliding the stator along the base plate. For handling the bearings and end bells light chain blocks on mono-rail supports were provided over the bearings. On the smaller outdoor air-cooled condenser installations the metal housings over the ends of the machines are large enough to permit the inspection of bearings, collector rings, or direct-connected exciters, and to remove bearing caps. For more extensive work the housing is readily removable in sections.

Outdoor installations for rotating machines have already proved of decided economic advantage under certain conditions. It is believed that with further development and operating experience the hydrogen-cooled machine promises to reach very high efficiencies, probably as high as 99 per cent for synchronous condenser installations.

FOREIGN PRACTICE

Letters received from the foreign members of the Foreign Practice Subcommittee indicate that in Argentine, Belgium, Brazil, Chile, England, Italy, and Mexico nothing has been done with hydrogen-cooled or air-cooled outdoor machines.

In France a 30,000 kv-a 11,000-volt hydrogen-cooled installation is under consideration for the Portet Saint-Simon Station of the Midi Railroad, but the information is not available whether the machine is going to be of indoor or outdoor type.

Two theoretical projects have been worked out in Germany but they have not been so far realized. They consist of two outdoor 30,000 kv-a air-cooled synchronous condensers and one 50,000 kv-a outdoor hydrogen-cooled synchronous condenser. In this case the increase of price of the air-cooled machine above the cost of an equivalent indoor machine was estimated to be about 15 per cent, and that of the hydrogen machine 10 per cent, above the cost of a normal indoor machine.

In Sweden a plant is under construction consisting of air-cooled generators protected by sheet iron housing.

COMPARATIVE COSTS

The answers to the question: "How did the complete cost of installation compare with an ordinary indoor installation of air-cooled equipment?" may be summarized as follows:

The comparative cost figures for ten

TABLE No. 2. OUTDOOR AIR-COOLED ROTATING MACHINERY

Summary of technical dates and operating results as reported by operating companies, the companies being designated by numbers.

Operating Company Number	Location of Installation	Class of Equipment	Date of Installation	Rating and Voltage	R.P.M.	Manufacturer	Protection from Weather	Air Filters	Comparison of Operating Costs with Indoor Machines.	Troubles Experienced	Description of installation and remarks
10.	Illinois	Synchr. condenser	1930	7500 kv-a. 6,600 V.	900	Allis-Chalmers	Sheet steel housing conforming to machine in outline.	No	About the same.	None	Outdoor transformer is connected overhead on high voltage side and by cable on low side. The switchgear is all indoors, the starting switchgear being Reyrolle type. No crane installed. Cost of installation about same as of indoor type. There are two exciters for high speed excitation and push button starting control.
11.	Canada	Synchr. condenser	1929-1930	4-25,000 kv-a. 13,200 V.	3,600	Canadian Westinghouse	Metal housing with ventilating louvers at ends.	Yes, dry type; silk and wool, medium with bronze screen.	About the same.	None	Steel switching structure and auto-transformer are outdoors. All operating equipment, switchboard and exciters are contained in the foundation. An 80-ton gantry crane is provided for use at time of maintenance as the rotors weigh about 80 tons and are more easily handled vertically. The saving due to outdoor installation is estimated to be about the cost of building above the units and the cost of the crane, or about 15 per cent of the cost of the complete installation if a building were built for the machinery. Fire protection by CO_2 gas discharged by differential relays. Rotor or field coil can be replaced in five hours. Machines are totally automatic.
12.	New York	Synchr. condenser	Installation not ready	3-30,000 kv-a. (on order)	-	G.E. Co.	-	-	-	-	No details available as the installation was not completed at the time of the report.
13.	Ohio	Synchr. condenser	1929	15,000 kv-a. 11,000 V.	900	G.E. Co.	Steel sheet housing conforming to machine in outline.	Yes, filter building provided.	About 15% lower.	Some bearing troubles due to oil rings failing to function. Vibration due to rotor being out of balance. Brushes overheated. Replaced with softer grade.	A brick air-filter building with connecting sheet metal ducts adjoins the condenser. The condenser is located in the building to protect the property. No crane is provided. Installation presents a very pleasing appearance and eliminates vibration from main building. Filter building is so arranged that hot air from condenser may be used for heating control building.
15.	Pennsylvania	Frequency converter.	Not stated.	2-21,400 kv-a. 16,000 V.	300	Westinghouse	Sheet steel housing conforming to machine in outline.	Yes, revolving oil coated screens.	About the same.	None	The machines are completely housed over with sheet metal and foundation space enclosed. The switchgear is located in the basement of the machine room. An outdoor steel structure accommodates switching equipment. No cranes are provided except two 1-1/2 ton monorail jib hoists for handling machine bearings. Saving of 15% obtained over indoor installation. Outdoor machines are more accessible for inspection, thereby avoiding difficulties and operating costs. Savings in windage losses in hydrogen for such slow speed machines would not be sufficiently great to justify the additional expense. A similar installation with unit of double rating is contemplated.
16.	No. Carolina	Synchr. condenser.	1929	10,000 kv-a.	900	G.E. Co.	Weatherproof housing on each end of machine.	Yes, Type not given.	About the same.	Bearing trouble.	Details not given.
16.	Pennsylvania	Synchr. condenser.	Not ready.	2-5,000 kv-a. (on order)	-	Allis-Chalmers	-	-	-	-	Details not available.

hydrogen-cooled installations indicate that:

Cost per kv-a was about the same in 5 cases.
Cost per kv-a was about from 10 per cent to 15 per cent lower in 2 cases.
Cost per kv-a was from 3½ per cent to 15 per cent higher in 3 cases.

The cost was lower in those instances where it would have been necessary to erect a building extension for at least two machines or to acquire real estate to accommodate a building.

The comparative costs for five outdoor, air-cooled installations show that:

Cost per kv-a was about the same in 3 cases.
Cost per kv-a was from 6 per cent to 10 per cent lower in 2 cases.

CONCLUSIONS

1. Outdoor rotating machines of the air-cooled type, and especially of the hydrogen-cooled type (except possibly two-unit machines such as frequency converters) offer attractive economies under certain conditions of installation.

2. The economies are not as pronounced in hydrogen-cooled machines in capacities less than 15,000 kv-a. Saving in windage losses at the higher speeds in machines of this capacity and larger should be appreciable.

3. Experience thus far has indicated sufficient possibilities to warrant further use and development of hydrogen-cooled machines.

TABLE 3.—Outdoor, Air-Cooled, Vertical Water-Wheel Generators

Operating Company	Number Location of Installation	Rating	Manufacturer	Description of Installation and Remarks
17	Michigan	2- 1,060 kv-a	Westinghouse	No information available
18	Montana	2-25,000 kv-a	"	" " "
19	Missouri	6-23,888 kv-a	"	" " "
20	Missouri	2- 3,000 kv-a	"	" " "
21	California	1- 4,000 kv-a	"	" " "
22	Massachusetts	1- 250 kv-a	"	" " "

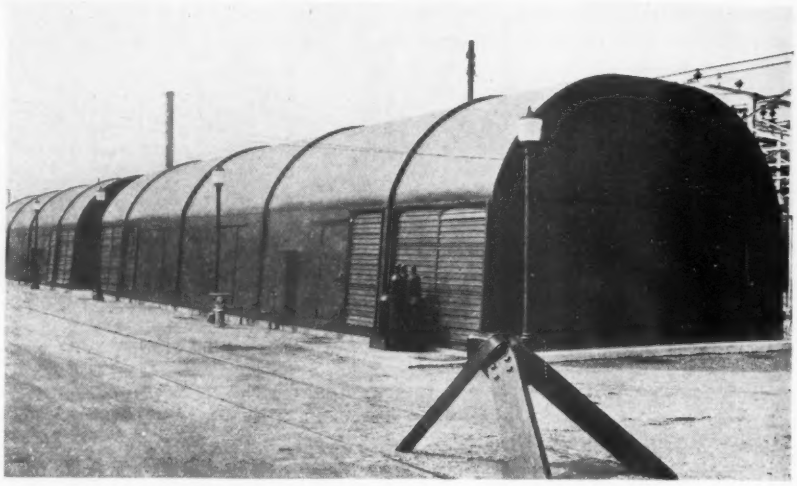
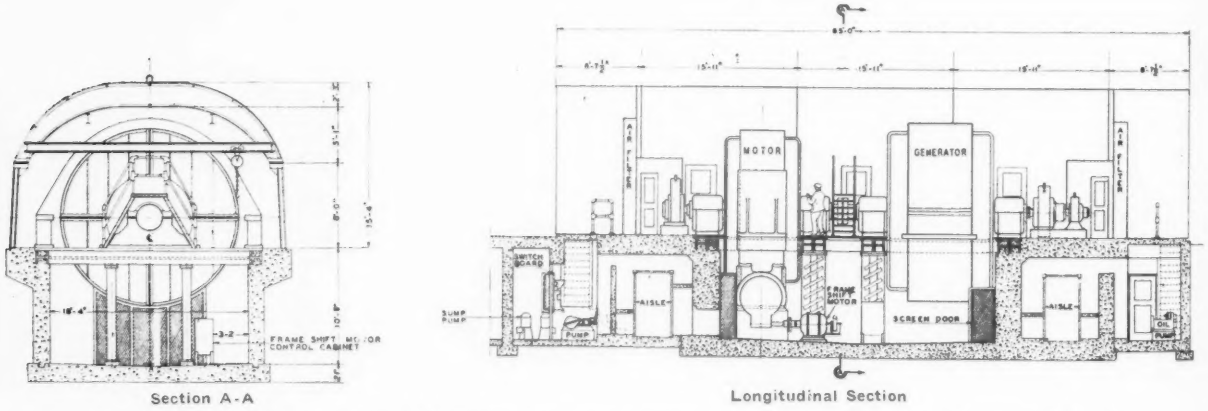


Fig. 10. Installation of two 15,000 kv-a outdoor air-cooled frequency changers. Company No. 14.



Section A-A Longitudinal Section

Fig. 11. Section of one of the 15,000 kv-a frequency changer sets shown in Fig. 10. Company No. 14.

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FOREIGN PRACTICE ON ARCING-GROUND SUPPRESSORS*

The following report is a summary of replies received from foreign members of the Foreign Practice Subcommittee to a questionnaire sent out in March, 1932, regarding the use of arcing-ground suppressors:

China

Mr. C. R. Webb, assistant chief engineer of the Shanghai Power Company, reports that there are no arcing-ground suppressors installed in China so far as he knows. The Shanghai Power Company lines are practically all underground with the neutral grounded through resistors.

England

Mr. C. W. Marshall of the Central Electricity Board states that the general practice in Great Britain is to earth the neutral directly or through resistors. The 132-kv. grid system has all neutral points directly earthed. No arcing-ground suppressors are used in Great Britain. Mr. Marshall feels that closely interconnected networks of high-voltage lines are not readily adaptable for the use of arcing-ground suppressors. He feels that the "ring main" duplication of supply with discriminative relay systems makes arcing-ground suppressors unnecessary.

France

Dr. Arnold Roth states that the general practice in France is to ground the neutral solidly, though the Paris system is grounded through a low reactance. He mentions two installations in France of dissonance coils made by Brown-Boveri Company, one on a 50-kv. system about 100 km. long, and another on a 35-kv. system about the same length. Dr. Roth feels that the principal objection to the use of arcing-ground suppressors is the difficulty of maintaining the proper balance between the reactance of the coil and the amount of line in service.

Italy

Mr. Rengo Norsa forwarded two replies from Italy as follows:

Mr. Hans Lutz of Turin described one case where a 70-kv. arcing-ground suppressor was installed, but the system was interconnected with another system before the suppressor was placed in service. He also mentioned the 220-kv. line from Cologne to Bludenz, Austria, a distance of about 700 km., on which Peterson coils are installed with good results. Mr. Lutz believes that solid grounding will be substituted for arcing-ground suppressors.

Mr. F. Motti of Naples reported one satisfactory installation of arcing-ground suppressors on a 30-kv. system at the Tanagro station. He also reported an installation on the 88-kv. Pescara line which proved to be a failure, on account of excessive residual current. This line is about 200 km. long and the excessive residual current was attributed to the fact that the spans are unusually short, resulting in a large number of insulators, most of which are rigid-type insulators with comparatively high capacitance to ground.

Japan

Dr. H. Tachikawa of Tokio reports that the general practice in Japan is to ground the neutral through resistance or reactance. Transmission systems in and near cities are generally operated with the neutral isolated to avoid excessive inductive interference. The installation of arcing-ground suppressors is making rapid progress at the present time. A total of 34 installations had been made up to July, 1932. Those 34 suppressors have a total rating of 105,500 kv-a. There is a total of 6390 km. of transmission line protected by arcing-ground suppressors. These have been installed on a basis of improvement in the reliability of service rather than economics.

Most of these suppressors have a 2-hr. rating and are equipped with taps for making adjustments to meet changes in the system set-up. From 80 to 94 per cent of all faults on these transmission lines are single-phase-ground faults, and 73 to 83 per cent of the single-phase-ground faults are suppressed without any interruption of service. Inductive interference is less serious on systems equipped with arcing-ground suppressors.

Sweden

Mr. K. E. Nylander of Stockholm reports that high-tension systems in Sweden are generally grounded through relatively high resistance though there is a noticeable tendency toward the use of arcing-ground suppressors. He mentions a 77-kv. transmission system with about 820 km. of lines protected by a 9000-kv-a. Peterson coil. Another 2220-kv-a. Peterson coil is being installed in connection with additions to the transmission system. These coils have a 2-hr. rating and are equipped with taps for the necessary adjustments. Experiments indicate that tuning within plus or minus 5 per cent is required for successful operation.

Germany

Dr. A. Menge, director of engineering of the Bavarian Power Company, reports that practically all high-voltage and medium-voltage transmission systems in Germany are equipped with arcing-ground suppressors. A few systems are operated with isolated neutrals, but there are no systems with the neutrals grounded through resistors or grounded solidly. A number of reasons are given for the use of arcing-ground suppressors. Ground faults do not necessarily cause interruptions and circuits may be kept in service until arrangements can be made to remove them. Ground-fault current is considerably reduced, lessening the duty on the generators and the system, reducing the damage at the fault, reducing the danger of the fault spreading to other phases, and reducing inductive interference. It has been repeatedly found that persons suffer no permanent injury from accidental contact with high-voltage systems protected by arcing-ground suppressors. The German Imperial Post Office opposes the solid grounding of the neutral on account of anticipated interference with the telephone system.

Dr. Menge describes the 110-kv. system of the Bavarian Power Company, which is metallically interconnected with two other systems. This group involves a total generating capacity of 427,000 kv-a. and 2640 km. of 100 kv. lines. This group is interconnected with two other neighboring systems through insulating transformers. This group of three systems is equipped with 13 arcing-ground suppressors with total rating of 52,350 kv-a. The individual units range from 1290 kv-a. to 8400 kv-a. These suppressors are of several different types and were furnished by several different manufacturers. Some are simple reactors connected to the neutral of power transformer banks, while others are in the form of grounding transformers connected directly to each of the three phases, they are all oil immersed in steel tanks. They are all designed to carry ground fault current for 2 hr. and are equipped with taps for making the necessary adjustments.

Wattmeter-type ground relays are used to locate faults on this system. The

* A report of the former Electrical Apparatus Committee, National Engineering Section, N.E.L.A., W. F. Sims, *Chairman*. Prepared by the Protective Equipment Subcommittee, R. T. Henry, *Chairman*.

relays are arranged to sound an alarm, but not to trip the circuit breakers. Operating records on this system show that during the past seven years there were a total of 431 faults, 321 or 74 per cent of these were single-phase-ground faults and caused no interruption, 110 or 26 per cent were short circuits and resulted in switching operations, all 431 would have caused interruptions without the arcing-ground suppressors. Of the 321 ground faults, 245 were suppressed immediately and 76 were left on the system until arrangements could be made to remove the faulty circuit. In 224 cases the fault did so little damage that its location was never found. There is no serious inductive interference on the telephone system even with some appreciable parallels.

Dr. Menge also mentioned the Prussian Electric System with 1200 km. of 100-kv. and 60-kv. lines. This system is equipped with Bauch grounding transformers built by Siemens-Schuckert Company. The operating experience on this system is similar to that on the Bavarian Power Company System.

Dr. Menge also mentioned the Shannon River Power System in the Irish Free State, with a generating capacity of 120,000 kw. with 2000 km. of 100-kv. and 40-kv. transmission lines, which is equipped with Siemens-Schuckert grounding transformers.

Dr. R. Rudenberg, chief electrical engineer of Siemens-Schuckert Company, states that before the invention of the Peterson coil all transmission systems in Germany were ungrounded. By 1929 67 per cent of all high-voltage and medium-voltage transmission systems in Germany were equipped with arcing-ground suppressors, and the percentage is even higher at the present time. Systems with the neutral solidly grounded, or grounded through resistance, are unknown in Germany. The Post Office Department opposes such methods of grounding.

Some of the advantages claimed for arcing-ground suppressors are—less personal hazard, less inductive interference, less danger of instability from single-phase grounds, and avoidance of interruptions due to single-phase-ground faults. It is common practice in Germany to arrange the ground relays for indication only and to keep faulty circuits in service until arrangements can be made to remove them.

The Siemens-Schuckert Company has built several hundred arcing-ground suppressors for voltages from 6 kv. to 100 kv., and for systems of from 100 km. to 2000 km. in length. The largest arcing-ground suppressor built by Siemens-Schuckert was a 7000-kv-a. coil for a 100-kv. system. All of these suppressors are equipped with taps for making the necessary adjustments to maintain the proper balance as the system set-up is changed. Dr. Rudenberg describes a number of systems and gives the operating records before and after the installation of arcing-ground suppressors, showing very considerable reduction in the number of interruptions.

Dr. O. K. Marti of the Brown-Boveri Company, states that his company has supplied a large number of arcing-ground suppressors using the Jonas System. He refers to one system in Central Europe consisting of 200 km. of 23,000-volt overhead lines which had serious trouble from frequent storms before 1926 when a 200-kv-a. "extinction coil" was installed. Since then the frequency of disturbances has dropped to a minimum and break-down of transformers, instrument transformers, and so forth, have been less numerous. Additional suppressors installed on account of the expansion of the system are giving equal satisfaction in parallel with the first one. This system has been operating satisfactorily even with residual current of as much as 7 amperes. There have been three cases on this system of persons involved in flashovers from live lines without any serious injury.

SUMMARY

To summarize briefly, the general practice is to ground the neutral of transmission systems solidly or through resistance in China, England, France, Italy, Japan and Sweden. The use of arcing-ground suppressors is increasing in Japan and Sweden and is almost universal in Germany.

The installation of arcing-ground suppressors is generally made on the basis of improvement to service rather than economics. Reduction of inductive interference and of the damage at the fault, and reduction of hazard to persons from accidental contact, are claimed as advantages of this form of protection. In Germany the Post Office Department opposes solid grounding of the neutral on account of anticipated inductive interference on the telephone system.

Practically all of the arcing-ground suppressors are immersed in oil in steel tanks and are of similar construction to modern power transformers. They are generally designed to carry ground fault current for 2 hr. and are equipped with taps for making adjustments to suit changes in the system set-up. Some transmission systems have a number of arcing-ground suppressors operating in parallel, but in such cases the supervision of the adjustment of individual suppressors must be centralized.

Replies from Germany and Japan indicate that from 75 to 90 per cent of all faults are single-phase grounds and that about 75 per cent of these are suppressed without any interruption. In many of these cases the damage is so slight that the location of the fault is never found. The faults which are not suppressed are generally left on until arrangements can be made to take the affected line out of service. There is very little danger of the fault spreading into the other phases. Inductive interference is not serious even with some appreciable parallels. No particular troubles were recorded either with the suppressors themselves or the systems on which they are installed.

Reference was made in the replies to a considerable number of technical articles on the subject of arcing-ground suppressors and some descriptive material was furnished by the manufacturers. If anyone is interested in a further study of these replies they are welcome to the use of any of this material.

ANOTHER RACKET SHATTERED

(*Continued from page* 166)

Claims are made that mechanical refrigerators devitalize the food and that this alleged devitalization of the food may be responsible for the increase in cancer, the prevalence of dental caries, and a list of ills vaguely indicated as 'toxic poisoning, constipation, acidosis, pyorrhea, rectal troubles' which 'plague the American people.' It is alleged that the 'respiratory' gases from foods refrigerated in hermetically sealed chambers 'as dry as Death Valley' devitalize the food and render it toxic. Some highly colored pictures of a cemetery are accompanied by statements that cancer mortality has doubled since 1900, as have deaths from appendicitis. Vague references are made to 'many leading authorities,' but these are not named. Acknowledgment is also made by the promoter, Mr. Teigen, to 'that great international authority on refrigeration, his former associate and employer.' This gentleman is not named, but information in the possession of The Journal indicates that the reference is to a Mr. J. M. Cattanach, of Minneapolis. The Journal has no evidence as to Mr. Cattanach's scientific attainments or to those of Mr. Teigen.

"A letter was addressed to Mr. Teigen asking him to elucidate certain of his claims. No answer was received, so a copy was sent again by registered mail. A return receipt for the registered communication is all the reply that has thus far been received, though six months have elapsed since the date on the return receipt.

"The circular to which reference is made appears to be sent unsolicited. Mr. Teigen, however, publishes a brochure which may

(*Continued on page* 196)

FOREIGN PRACTICE ON INSULATING OILS IN TRANSFORMERS AND OIL CIRCUIT BREAKERS*

In the study of insulating oil practice of foreign utility companies, which was conducted during 1931-1932 by the Foreign Practice Subcommittee under the direction of Chairman A. H. Lawton, special attention was directed towards those differences in technique and operation which were thought valuable enough to be brought to the attention of the Electrical Apparatus Committee. A mass of information has been received but only the high spots have been included in this report.

OIL SPECIFICATIONS

Table No. 1 giving the detail characteristics of various foreign oils shows the degree of care which is expended abroad in specifying the different brands and types of oil. The one outstanding comparison in this table is the fact that our American practice has progressed to the point where one oil, having universal characteristics, fills the need for both transformers and circuit breakers. The British Standard Specification calls for six oils; the Germans have two specifications; the Tokyo Electric Company uses four oils—all varying as to pour points, with the other elements practically the same. Oil simplification in the U. S. A. has been accelerated by the fact that we have an installed generating capacity of over 35,000,000 kw or 35 per cent** of the world's power supply. Economic and service demands have forced a reduction in the many grades of oil formerly required by the correspondingly large transformer and oil circuit breaker capacity.

The six grades of oil used in England and in her provinces are divided into two temperature classes. The Class A oils are used in transformers with a temperature exceeding 80 deg. C. and in breakers not exceeding 70 deg. C. They are used in all oil circuit breakers with a capacity above 500 amperes having main contacts under oil and operating for a long time at maximum current or in warm locations. The Class B oils are used in transformers with a temperature not exceeding 75 deg. C. They are also used in breakers not subjected to the conditions requiring the use of oils in Class A.

Oil specifications used in Germany for transformers and oil circuit breakers are furnished by the German Association of Electrical Engineers (VDE 405) and by the "Richlinien fur den Einkauf und die Prufung von Schmiermitteln aufgestellt und herausgegeben von dem Verein deutscher Eisenhuttenleute (Rules for the purchase and the testing of Lubricants, established and published by the German Union of Iron Masters). According to Dr. Menge, a member of the Foreign Practice Subcommittee, most of the German manufacturers of large transformers and circuit breakers permit the changing and mixing of oil in their apparatus providing the replacement oil meets the VDE 405 specification and where laboratory tests of the mixture do not disclose any conspicuous change in the previous characteristics. Dr. Menge's company does not lay down any special rules for purchase of oil directly from refiners but gives preference to oils showing especially valuable properties over and above those of the VDE specifications. His experience with oil furnished directly from the oil refiners has been designated throughout as satisfactory.

ARTIFICIAL AGEING

Methods for determining artificial ageing are not uniform in any of the foreign countries under study as neither the temperature of accelerated heating nor the time duration under test has been simplified or standardized. A survey of the various methods indicated in Table II discloses the urgent need for a simple uniform method of determining the sludging rate.

The *"verteerungszahl"* (*tar content number*) of the German method indicates the content of soluble constituents in the oils in a hydro-alcoholic soda wash, which become visible after prolonged heating in the presence or in the absence of oxygen. This test permits the checking of the tendency which the oil has to give tarry materials in service.

Le Schweizerischer Verband while insisting on the indefinite character of this test have recognized officially up to the present only the test of artificial ageing for turbine oils.

The British Standards describe the sludge method which consists of heating the oil in the presence of a plate of electrolytic copper (51 mm—32 mm—0.1 mm) in a bath of oil held at 150 deg. C. for 45 hr. bubbling into the oil at the rate of two litres per hour a current of air purified by its passage over solutions of soda and silver nitrate and dried during this passage by concentrated sulphuric acid. The oil is cooled to 100 deg. C. and 300 cc. of petroleum ether added. After shaking, it is set aside for at least 16 hr. and not more than 24 hr. for the deposit to separate out. The precipitate is filtered on a double filter, after having washed it twice by decantation not using more than 300 cc. of washing ether. The deposit is dried at 100 deg. C. until a constant weight is reached, which gives directly the content of the deposit.

It should be noted that the Swedish A. S. E. A. Anderson method assimulates actual operating conditions by utilizing copper and iron as a catalytic agent in an electrical field of 10 Kv. per cm.

The Belgian report applying to insulating oil specified that the oil, heated for 5 hr. at 170 deg. C., can show only a slight alteration in tint and must not leave any apparent deposit on the quantitative filter.

In addition to these described methods officially, there are in existence other processes of ageing, a great number of which are not described so as to simplify the comparison of the characteristics of mineral oils. Of special interest is the fact that the duration of the ageing tests varies from 30 min. by the Waters test to 672 hr. by the "SOFINA" test while the temperatures vary from 250 deg. and 110 deg. C. respectively. Lucien Janlet, a member of the Foreign Practice Subcommittee, describing the work of the "SOFINA" (Societe Financiere De Transports Et D'Entreprises Industrielles) Oil Testing Laboratories writes as follows:

"Studies, which have been undertaken by our Laboratories on the oxidation of special oils, have shown the importance which must be attributed to tests of artificial ageing. For this purpose we submit special oils to an ageing test of long duration (672 hours or 28 days at 110 deg. C.) without any metallic catalytic agent whose selective influence we are afraid of. Each week the oil is examined from a point of view of color, appearance and the eventual presence of a deposit, and the organic acidity is determined. The classification of oils which results from this will conform, all accidental deterioration put aside, to the classification obtained by taking as a criterion the standing-up of the oils in service.

"Other tests are likewise carried out but the quality of insulating oils has improved to such an extent in recent years that it is

*A report of the former Electrical Apparatus Committee, Engineering National Section, N.E.L.A., W. F. Sims, *Chairman*. Prepared by the Insulating Oils Subject Committee, G. Sutherland, *Chairman*.

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TABLE I—FOREIGN OILS FOR TRANSFORMERS AND CIRCUIT BREAKERS

Characteristics	Richtlinien for den Einkauf und die Prufung von Schmiermitteln	British Standard Specification for Insulating Oils for Electrical Purposes #148 - 1927						Comite Electrotechnique - Belge Report No. 15
		A.0	A.10	A.30	B.0	B.10	B.30	
Nature of the oil	Refined	Pure mineral oil, clean and free from moisture or other matter likely to injure its insulating properties.						The oils must be mineral, sufficiently refined.
Specific Weight	at 20°C. 0.920 0.895 (1)	-	-	-	-	-	-	at 15° 0.85 - 0.92
Flash Point	145°C	145°C	145°C	145°C	145°C	145°C	145°C	145°C
Pour Point	-15°C -40°C (1)	- 0°C	- -10°C	- -30°C	- 0°C	- -10°C	- -30°C	-15°C (outdoor) -5°C (indoor)
Viscosity European	8°E @ 20°C	200 Sec. Redwood @15.5°C	200 Sec. Redwood @15.5°C	200 Sec. Redwood @15.5°C	200 Sec. Redwood @15.5°C	200 Sec. Redwood @15.5°C	200 Sec. Redwood @15.5°C	2.5°E @ 50° 1.5°E @ 75°
Equivalent Saybolt Sec.	273 @ 20°C	236 at 15.5°C	236 at 15.5°C	236 at 15.5°C	236 at. 15.5°C	236 at 15.5°C	236 at 15.5°C	84 @ 50° 47 @ 75°
Evaporation	-	1.6%	1.6%	1.6%	1.6%	1.6%	1.6%	1.5%
Index of Acidity	0.05	-	-	-	-	-	-	-
Artificial Ageing	Tar index - 0.1% (2)	Sludge 0.1%	Sludge 0.1%	Sludge 0.1%	Sludge 0.1%	Sludge 0.8%	Sludge 0.8%	Heating at 170 deg. C for 5 hours without any deposit
Water Content	-	-	-	-	-	-	-	None
Ash Content	0.01%	-	-	-	-	-	-	-
Foreign Solid Materials	-	-	-	-	-	-	-	None
Dielectric Strength	Oil ready for filling: 125 Kv/cm or 31.8 Kv/0.1 inch. In service the dielectric strength cannot be lower than 80 kv/cm, or 20.3 Kv/0.1 inch	30,000 V (3)	30,000 V (3)	30,000 V (3)	30,000 V (3)	30,000 V (3)	30,000 V (3)	Oil as taken 18000 V Oil dehydrated 25000 V (4)
Equivalent ASTM Method with gap 0.10 inch and 1.0 inch diameter disks		15,000 V	15,000 V	15,000 V	15,000 V	15,000 V	15,000 V	Oil as taken 9,000 V Oil as dehydrated 12,500 V

(1) For transformers and breakers in contact with the air and which do not have any special heating installations.
(2) 70 hours at 120 degrees Centigrade with oxygen.
(3) The electrodes are brass spheres 13 mm. in diameter arranged horizontally with the separation of 4 mm.
(4) Electrodes 2 mm. apart.

TABLE I (CONTINUED)—FOREIGN OILS FOR TRANSFORMERS AND CIRCUIT BREAKERS

Characteristics	Oil Furnished to Dr Menge, Bayernwerk A.G. (a State Owned Operating Company) Munich Under German Specification VDE 405			Tokyo Electric Light Company (Japan) Specification				l'Union de Syndicates d'Electricite Francaise	N.E.L.A. Suggested Oil Specification
				Transformer Oil		Switch Oil			
	K-7 Rheinaliz Osseg Company	Supra-Albrecht Company	Russian Oil Schliesanna Co	No. 1	No. 2	No. 1	No. 2		
Nature of the oil	Almost clear as water, greenish	Almost clear as water, greenish	Almost clear as water, greenish	Mineral oil sufficiently refined				No Sulphur	Mineral oil free from organic acids alkalis or sulphur
Specific weight	at 20°C 0.8676	at 20°C 0.9067	at 20°C 0.8806	0.91 @ 15°C	0.93	0.92 @ 15°C	0.95	0.85 to 0.92 @ 15°C	-
Flash Point	168°C	153°C	162°C	130°C	145°C	130°C	160°C	160°C	120°C
Pour Point	Still fluid at -48°C	Still fluid at -35°C	Still fluid at -20°C	-10°C	-5°C	-20°C	-10°C	-5°C	-40°C
Viscosity - European	5.7°E @ 20°C	8.0°E @ 20°C	5.4°E @ 20°C	5°E @ 20°C	7.5°E @ 20°C	8°E @ 20°C	12.8°E @ 20°C	2.5°E @ 50°C	-
Equivalent Saybolt Sec.	194 @ 20°C	284 @ 20°C	188 @ 20°C	170 @ 20°C	255 @ 20°C	278 @ 20°C	440 @ 20°C	84 @ 50°C	60 Sec Saybolt at 37.8°C
Evaporation	-	-	-	0.8%	0.2%	0.5%	0.2%	-	-
Index of Acidity	0.026	0.07	0.046	0.05	0.05	0.10	0.10	0.02% in H_2SO_4	0.05 mg KOH to neutralize 19 V of oil
Artificial Ageing	-	-	-	Heating at 140°C for 8 hrs and left to stand at room temperature for 20 hrs shall form no sludge.		Heating at 100°C for 8 hrs and left to stand at room temperature for 20 hrs shall form no sludge.		No sludge up to 50 hrs heating at 150°C in D.S.E. Test Method.	No sludge after heating 18 days in Snyder Life Test
Water Content	Trace	Free	Slight trace	-		-		-	-
Ash Content	Imponderable trace	Imponderable trace	Imponderable trace	-		-		-	-
Dielectric Strength	-	-	-	25 Kv (5)	25 KV (5)	25 Kv (5)	25 Kv (5)	40 Kv (6)	
Equivalent ASTM Method with gap 0.10 inch and 1.0 inch diameter disks	-	-	-	25 Kv	25 Kv	25 Kv	25 Kv	20 Kv	22 Kv

(5) Electrodes of 2.5 mm diameter spaced 2.5 mm (6) V.S.E. Standard Test

very rare that a product must be rejected on account of general characteristics.

"The dielectric strength which is an important property and the pour point must always be checked with the greatest of care.

"This method of work has permitted the setting aside with certainty those firms whose refining has not been good enough, or firms whose products have not shown constant results; this has, moreover, shown the exceptional quality of oils obtained by certain refining processes (Edeleanu for example).

"The results of our ageing tests have influenced certain firms to change their method of manufacture and to obtain from these conditions products of better quality.

"The danger of mixing mineral oils having different characteristics, the catalytic role of metals, the influence of keeping in stock have also been studied in the same manner."

Dr. H. Tachikawa, the Japanese member of Foreign Practice Subcommittee and managing director and chief engineer of the Tokyo Electric Company, gave the following explanation for his oil specification (See Table I):

Transformer Oils

"1. Standard rules for insulating oils were discussed by our Japanese National Committee of the International Electro-Technical Commission. There is no telling when such universal standard specifications might be approved. Furthermore, characteristics of domestic oils are somewhat different from those of foreign products, which might cause inability to draw such a universally common specification. Such being the present circumstances, the standard specification shown in Table I has been drawn to meet the urgent need for principally domestic products for our system.

"2. Sometimes it is more convenient to group transformer oils and switch oils together under the name of insulating oils, but both of them have characteristics somewhat different from each other, and this specification is exclusively for transformer oils.

"3. Reasons for classifying transformer oils into two kinds are wholly due to the

TABLE II—COMPARISON OF FOREIGN OIL AGEING METHODS

METHOD USED	QUANTITY OF OIL USED	RECEPTACLE	TEMPERATURE	LENGTH OF TEST IN HOURS	AIR OR OXYGEN	QUANTITY OF AIR OR OXYGEN	CATALYTIC AGENT	CRITERION USED FOR DETERMINING THE QUALITY OF THE OIL
German Method (Verteerungszahl)	150 gr.	Erlenmeyer glass flask 300 cc.	120 Deg. C	70	Oxygen	2 bubbles per second through a 3mm dia. tube	None	Solid constituents from the alcohol washing. Index of acidity. Index of saponification. Asphalt content.
French Method	about 12 gr.	15 x 150 - 160 mm glass	150 "	5-50-150	Air	Surface	None	Weight of the deposit formed. Change in the color of the oil.
English Method (Wichie Test)	100 cc.	Vessel with cooling apparatus	150 "	45	Air	2 litres per hour	Copper	Weight of the deposit formed.
Italian Method (A.E.I.)	40 gr.	25 x 190 mm in glass	110 "	300	Air	Surface	Copper	Weight of the deposit. Index of acidity. Change in the resistance of the cotton.
Swiss Method BBC	1000 cc.	Copper vessel	115 "	168 - 336	Air	Surface	Copper Receptacle	Volume of the asphalt. Change in the resistance of the cotton.
Swedish Method (Staatlicher Prufungsamt)	100 cc.	Glass vessel round flask 200 cc. with air cooling	120 "	70	Oxygen	2 litres per hour	Copper Cylinders 32 x 51x 0.1 mm.	Weight of the deposit formed and of the asphalt.
Swedish Method	1000 cc.	Glass vessel	120 "	70	Oxygen	Surface	None	Weight of pitch. Clearness of the oil.
Swedish Method (Anderson-ASEA)	60 gr.	Glass vessel	100 "	100	Oxygen	1 litre per hour	Copper iron electrical field of 10 kv/cm	Weight of the asphalt formed. Index of acidity of the oil and of the asphalt.
Russian Method (Butkow)	25 cc.	Glass vessel - calorimetric bomb	150 "	5	Oxygen	14 atmospheres	None	Weight of the asphalt formed. Index of acidity in deposit.
Belgian Method	40 cc.	Glass vessel - 50 mm. diameter - 37 mm. high	170 "	5	Air	Surface	None	Any deposit
Baader Method	60 cc.	Glass vessel with cooling	95 "	48	Air	Surface	Glass, lead copper, iron, spiral	Index of saponification

TABLE II (CONTINUED)—COMPARISON OF FOREIGN OIL AGEING METHODS

METHOD USED	QUANTITY OF OIL USED	RECEPTACLE	TEMPERATURE	LENGTH OF TEST IN HOURS	AIR OR OXYGEN	QUANTITY OF AIR OR OXYGEN	CATALYTIC AGENT	CRITERION USED FOR DETERMINING THE QUALITY OF THE OIL
Maschalko & Barna Method	0.1 gr.	Glass vessel 20 cc. connected to oxygen burette	150-200 degree C.	Up to 45	Oxygen	Contents of vessel	None	Quantity of oxygen absorbed.
A.E.G. Method (Transformer Tests)	4500 gr.	Glass vessel	90 deg.	6 months	Air	Surface	Copper, iron cotton, electrical field	Index of acidity, tar index. Weight of the asphalt formed.
Russian Method	100 cc.	Glass vessel	120 "	7	Oxygen	Introduced	Copper	Volume of the deposit, index of acidity. Resinous content.
Waters Method	10 gr.	Glass vessel - 150 cc.	250 "	1/2	Air	Surface	Metallic powder	Weight of asphalt formed.
Weiss and Salomon Method	65 cc.	Special shaped glass vessel	115 "	varies with the oil	Air	Surface	Copper spiral	Time of the first deposit under heat. Evolution of the above as a function of time and parallel progress of the acidity.
Sofina Method	about 500 cc.	Glass vessel	110 "	672	Air	Surface	None	Weekly determination of the appearance of the oil, its acidity and the amount of deposit.
A.S.T.M. Committee D-9 Vol 27, 1927 Proceedings Part I Page 541 (Snyder - U.S.A.)	500 cc.	Glass vessel	120 "	Days until sludge appears	Air	1.5 cu ft per hour	None	Number of days before first trace of sludge appears in the specimen.

principles of item 1; that is, domestic products can roughly be classified into two kinds, those with light specific gravity, low flash point, low viscosity, and others with heavy specific gravity, high flash point, and high viscosity; furthermore, it has been considered convenient for consumers to do so, because they can then choose either kind to meet their transformer design and their different requirements. Namely, No. 1 kind of transformer oils is applicable where cooling plays an important part, such as in transformers of comparatively large capacity; whereas No. 2 kind of transformer oils is applicable where it is difficult to inspect regularly, such as in pole transformers.

Switch Oils

"1. Classification of switch oils into two kinds in this specification is due chiefly to their characteristics, but speaking from the purposes of usage in practice, No. 1 kind is applicable to outdoor in cold locality, and No. 2 to other cases.

"2. It is not absolutely necessary that switch oils should have high flash point. This point has been especially investigated by the committee, and this conclusion has been reached after making practical tests of the rupturing capacity of oil circuit breakers with various oils. Therefore, the values specified show a substantial margin over those obtained in service. Above tests were conducted at Hatogaya Primary Substation of Tokyo Electric Light Company.

"In addition, it is to be generally understood, unless otherwise specified, that opinions and documents hereafter submitted to you are entirely on my own responsibility, and they are not, in any sense, representative of our country."

OIL IN SERVICE

Tests conducted by "SOFINA" (Societe Financiere de Transports et D'Entreprises Industrielles) find that mineral oils reaching even in normal service a degree of deterioration beyond which their use becomes dangerous, make it necessary for safety in service that this state of ageing be regularly checked in such a manner as to guard against any accidental and unforeseen cause of deterioration. Certain companies carry out the majority of these check tests of oils in service on the site.

At the time of the building up of the organization for testing the oils in service they discovered that it was preferable to centralize the test in "SOFINA'S" laboratories which permitted the use of the same methods, their continual improvement and the trying out of new tests. As it is practically impossible to determine previously the number of samples to be taken for oils in service, they have considered it advisable to take one sample in transformers and turbines every six months, besides the number of samples can be increased or diminished

depending on the importance and the incidents in service.

From what moment in the life of an oil can it bring on serious and burdensome accidents and when is it necessary to consider replacing or purifying it? Up to the present, "SOFINA" has followed the German recommendations which consider that insulating oils can continue to fulfill their function for as long a time as their index of acidity is less than 1.5 and their index of saponification less than 3.0. Moreover, these limits of service are not admitted by all the specialists, and Levien, among others, has pointed out that they were not strict enough and that these specifications should be corrected in the following manner:

Index of acidity	0.75
Index of saponification	1.20

A comment received on the English Oil Specification No. 148 was presented by C. R. Webb, Shanghai Power Company, who said:

"It has been our experience, after trying several grades of oil complying either with B.E.S.A. "B" or B.E.S.A. "A" specifications for oil circuit breakers, that we have not yet found a satisfactory oil for circuit breakers of over 1200 ampere rating. Breakers of this size and over require to have their tanks dropped and contacts cleaned every three months in order to prevent overheating due to a film forming on the contacts themselves."

The oil meeting the requirements of the B. E. S. A. specification No. 148 is being supplied by the Vacuum Oil Company, Standard Oil Company, Asiatic Petroleum Company, Ltd., and the Texas Company.

A. Roth, the French member of the Foreign Practice Subcommittee, while sending the specification of the Union des Syndicates d'Electricite Francaise (U. S. E.) presented in Table I, declared:

"For the circuit breakers, the characteristics are those of the U.S.E. with the congealing point as requested. Besides, I am convinced that for breakers the question of oil is almost without influence."

The Mexican Light and Power Company had purchased their first tank car of insulating oil direct from a refiner (Aguila Company) in April, 1932, and while the preliminary results have been satisfactory their experience as yet has been too limited to be of much value. They had formerly been using the oils supplied by American electrical manufacturers.

Replies to questionnaires similar to those on which the N. E. L. A. Serial Report No. 289-48, Storage, Handling, Treatment, Inspection and Testing of Insulating Oils was based, indicate that the larger foreign electric companies are just as vitally concerned with their insulating oil as are the American utility operators. Climatic conditions are greatly taken advantage of so costs can be lowered by placing much of the equipment, such as tanks and piping above ground. What is considered good practice in America is generally followed in foreign fields. Care in providing separate clean and dirty pipe lines is followed where the volume of oil is large. Oil is not generally purchased on specification but is secured through the electrical apparatus manufacturer. Of the two types of oil filtering devices, the filter press is the most popular—again checking American practice. The Rio de Janeiro Tramway Light & Power Company reports that once an oil has been used in circuit breakers it is *never* used after filtering in transformers. This organization being typical of foreign installations makes the regular visual inspection for sediment and the regular tests for dielectric strength, free water and carbon. The oil is filtered if it shows sludge, free water, carbon or low dielectric strength of 22 Kv. for transformers or 18 Kv. for oil circuit breakers. The Compania Interprovincial de Servicios Publicos S. A. Buenos Aires through D. H. Matson, a member of the Foreign Practice Subcommittee writes as follows:

"The tendency in this country is for public utility companies to buy insulating oils directly from the manufacturers of electrical equipment purchased both American and European, there being no electrical factories of any importance in Argentine. We had at one time considered purchasing oil directly from the refiners but our purchases of oil at the present time are not sufficient to warrant this. We accept European oil furnished directly by European manufacturers and have found this oil to give satisfactory results in all of our equipment both for low and high voltage service. All the oils we have in use have been giving satisfactory service and we have noted no

(Continued on page 192)

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GEORGE C. WARD

George Clinton Ward, president of the Southern California Edison Company, Ltd., Los Angeles, Cal., one of the most distinguished figures in American engineering and electric utility op-

eration, died Monday, Sept. 11, at the Good Samaritan Hospital in Los Angeles. His death was caused by a complication of ailments, aggravated by heart disease. He was 70 years of age. (Born Jan. 9, 1863, at White Plains, N. Y.)

Builder of the Edison company's hydroelectric generating system in the High Sierra of Central California, Mr. Ward contributed more perhaps than any other individual to the physical and economic growth of Southern California, through the development of a large supply of electric energy. He personally, in 1911, made the first reconnaissance of the hydroelectric power sources of the High Sierra and under his direction the initial undertaking of transmitting electric power from Big Creek on the San Joaquin River to Southern California was successfully completed and new transmission methods were developed which are now standard practice throughout the world.

Other engineering projects of an earlier date that also were of vast importance to the development of Southern California, in which Mr. Ward was one of the outstanding personalities, included the construction of the Los Angeles Railway and the Pacific Electric Railway systems. In these projects Mr. Ward was associated with Henry E. Huntington as engineering adviser.

Mr. Ward became a member of the Edison company executive staff in 1917, beginning years of intimate association with the late John Barnes Miller and the late Russell Henry Ballard, former chairman and former president of the company, respectively. Since 1911 he had been vice-president of the Pacific Light and Power Company, a Huntington organization. With the consolidation of the Edison company and the Pacific Light and Power Company in 1917, to form the Southern California Edison Company, Mr. Ward became vice-president in charge of construction. In March, 1928, Mr. Ward was appointed executive vice-president of the company, continuing his personal direction of construction activities. He became senior vice-president in December, 1931, and was appointed to the presidency on Oct. 18, 1932, succeeding to the office made vacant by the death of Mr. Ballard.

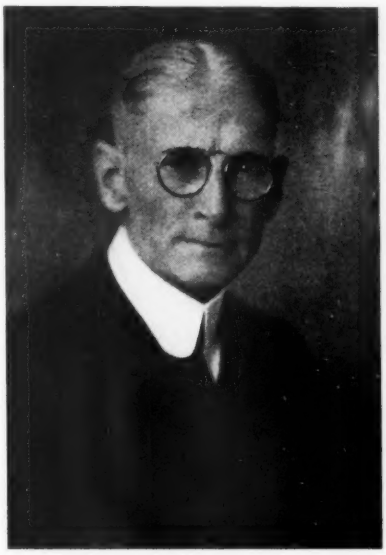
Through his many years of activity as an executive officer of the Edison Company, Mr. Ward had a close association with the personnel of the company and the regard of the men and women of the organization for him was of the highest.

In recognition of his many engineering accomplishments, Mr. Ward has been honored on numerous occasions. In 1925, the United States Chamber of Commerce presented him with a bronze medallion commemorating the completion of the Florence Lake Tunnel on Feb. 18 of that year. He was given the honorary degree of Doctor of Engineering by the University of Southern California in June, 1927, and the following year, Oberlin College, Ohio, honored him with the degree of Doctor of Science. Early this year (1933) he was made an honorary life member of the Los Angeles Engineers' Club.

Mr. Ward's residence in South Pasadena had been his home for the past twenty-five years. He had many interesting hobbies, among them the collection of relics of the Indians of the Southwest and concerning which he was an authority. He was a member of several clubs, including the California Club, Jonathan Club, Sunset Club and Zamorana Club. He also was a Knight Templar and a thirty-second degree Mason. Mr. Ward was an associate member of the board of trustees of California Institute of Technology and an honorary member of the American Society of Civil Engineers.

ROBERT LINDSAY

Robert Lindsay, president and general manager of The Cleveland Electric Illuminating Company, died on Aug. 25 at his home at University, Va., at the age of 63.



Mr. Lindsay was a pioneer in the electrical industry. He was born in Rahway, N. J., Sept. 14, 1869, his home being a short distance from Menlo Park, N. J., where Thomas Alva Edison developed the incandescent electric lamp in 1879.

As a child, Mr. Lindsay often visited Menlo Park. At 16, on his own initiative, he obtained employment in the Edison Lamp Factory at Harrison, N. J., and his ability soon won the recognition of Mr. Edison and his chief associates. He was only 20 when, in 1889, he became assistant to the general manager of the Brooklyn Edison Company. In 1893 he went to Cleveland as consulting engineer on the design of a power plant of The Cleveland Electric Illuminating Company. In 1894, he returned to Cleveland as general superintendent of the company.

For 39 years Mr. Lindsay devoted himself completely to the service of the company and the community and the development of the art and science of electricity. It is generally recognized that the extraordinary development of the many branches of the electrical industry in the greater Cleveland district is due in no small degree to his genius and leadership.

Mr. Lindsay's reputation was national. Member of numerous business

(*Continued on page* 196)

SELECTIVE DEVICES FOR REDUCING RIPPLES IN D-C SYSTEMS

Alternating components or ripples are frequently present in the voltage and current of d-c generators or other apparatus for converting from alternating to direct current. These components are ordinarily so small as to have no effect on the operation of d-c power or traction systems. However, there have been cases where noise-frequency induction problems arose in exposures between d-c systems and telephone circuits. In those instances where reduction of the ripples, rather than changes in the telephone system, appeared to offer the best solution, this was accomplished by the application of one of several types of selective devices. A selective device is a combination of reactors and capacitors connected in such a way as to be selective as to frequency for the purpose of reducing the amount of the ripple on the system.

The design and application of a number of selective devices for d-c systems is discussed in Technical Report 1C-10 of the Joint Subcommittee on Development and Research. These include simple series or shunt devices as well as combinations of series and shunt elements commonly termed filters. Of these several devices, the resonant shunt probably is employed more frequently than any other. A description of it will serve to illustrate some of the characteristics of these devices.

The resonant shunt consists of a reactor and a capacitor in series, and is connected in shunt across the bus. The reactor and capacitor are tuned (i.e., inductive reactance of former made equal to capacitive reactance of latter) for the frequency of the alternating component which it is desired to reduce. At this tuned frequency the impedance of the shunt is very small, being practically the effective resistance of the reactor. Since the function of the resonant shunt is to provide a local short-circuiting path for the alternating component in question, it is always located in the same station as the machine in which that component arises.

There are of course a large number of combinations of inductance and capacitance which will give resonance at any particular frequency. The selection of the appropriate values for a reactor and capacitor comprising a resonant shunt depends on the desired degree of reduction in the ripple (B), the ratio of reactance to effective resistance of the reactor at the tuned frequency (Q) and the impedances of the machine (Z_o) and the system (Z_L) at that frequency. A convenient expression for the inductance in terms of these quantities is

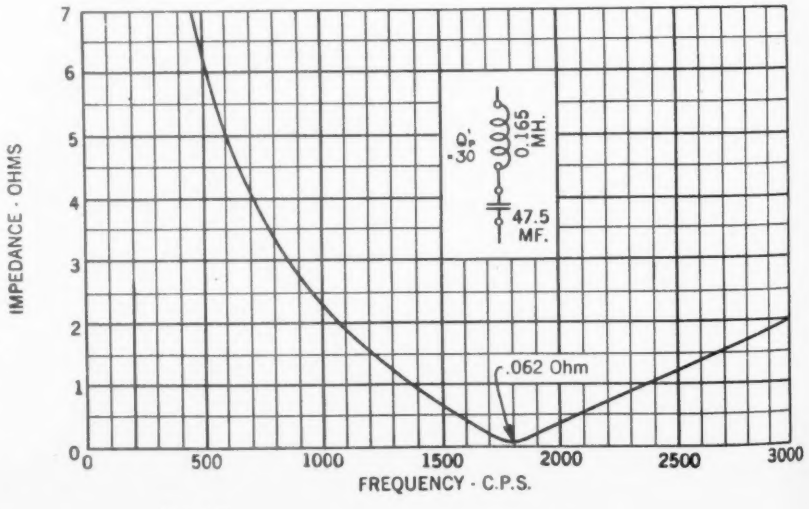
$$L = \frac{Q\ (10^3)}{2\ \pi\ f\ B} \times \frac{Z_o + Z_L}{Z_o\ Z_L} \quad \text{mh}$$

The value of the capacitor is determined by the fact that its reactance is equal, in magnitude, to the inductive reactance of the capacitor at the tuned frequency. The value of inductance given by the above expression is not critical, but may be changed somewhat when necessary to permit obtaining resonance with capacitor sizes commercially available.

From the operating standpoint, the reactor need be designed to carry only the alternating component current, since the capacitor blocks the passage of the direct current. The capacitor must also be able to carry this alternating current and in addition withstand the peak voltage of the system.

It has been mentioned that the impedances of the machine and system at the alternating component frequency affect the constants required for the reactor and capacitor. It should be added that the magnitudes of these impedances are of importance in determining which of the various types of selective devices are suitable in a given case. For example, resonant shunts are well adapted for reducing slot harmonics in rotating machines. However, for mercury arc rectifiers resonant shunts alone are not suitable, because of the low internal impedance of the rectifiers. In this case, the addition of a reactor in series between the rectifier and the system, with resonant shunts connected on the system side of the series reactor, provides a combination which is very effective.

As an illustration of the order of magnitude of the quantities involved in this problem, the following are the major points of a case involving a 1000 kw synchronous converter supplying a 600 volt street railway system. Preliminary measurements showed that the machine generated an 1800 cycle voltage of 22 volts, and had an internal impedance at that frequency of 0.63 ohm. Assuming that the system impedance was large compared with the machine impedance, the inductance of the reactor was calculated from the relation given previously as 0.165 mh. This was for a ratio of reactance to effective resistance (Q) of 30, and a desired reduction (B) of 10 to 1. The corresponding capacitance for tuning at 1800 cycles is 47.5 mf. The impedance curve for this shunt is shown in the accompanying diagram. Measurements showed that the shunt reduced the 1800 cycle voltage of the machine from 22. to 2.4 volts. The 1800 cycle current circulating between the machine and the shunt was 35 amperes, and the peak voltage across the capacitor was 690 volts.



INDUSTRIAL HEATING NEWS

Contributed by Industrial Power & Heating Committee, E.E.I.

OIL IMMERSION HEATERS FOR AIRCRAFT ENGINES

With the coming of cold weather, a timely load builder that commends itself for immediate exploitation is the oil immersion heater for aircraft engines.

Aircraft engines should be "warmed up" before they are operated at, or near, rated power output. This is to prevent too rapid heating of the engine parts and also to obtain proper action of the lubricating oil. The process, therefore, has two distinct functions—that of "warming up" the engine and heating the oil supply.

By running the cold engine slowly, the former can be accomplished in a few minutes. However, considerably more time is required to heat the oil supply to the correct temperature. This is because there is a relatively large amount of oil to be heated and only a small part is in contact with the engine at any one time. If the oil heating is dependent on engine heat alone, it is necessary to wait until the entire supply of oil has been pumped through the engine a sufficient number of times to raise its temperature to the required amount. This may be a matter of ten minutes or a half hour. In cases of extreme cold weather, it is usually imperative to pre-heat the oil before even starting the engine. This is often accomplished by draining the oil at the conclusion of flying, and heating it before it is replaced in the ship's tank to resume operation.

Oil immersion heaters for aircraft engines are designed to heat the lubricating oil without the aid of the engine and without the necessity of draining and refilling in cold weather. These heaters are intended for use as a part of the ground equipment rather than for permanent installation in ships. They are portable, convenient to use, and shaped for easy insertion through oil-tank filler caps.

ELECTRIC HEAT AIDS IN PREPARATION OF TENNIS EQUIPMENT

What with the sporting pages of our daily newspapers recently carrying stirring accounts of the sparkling tennis campaigns at Wimbledon and Forest Hills, it is timely to tell how electric heat is being effectively employed in the preparation of tennis equipment at the Dunlop Tire and Rubber Company, Buffalo, New York. They have two electrically heated equipments as follows:

A small cabinet type drying kiln for drying tennis racquets in which 10 kw. of strip heaters are installed in the duct work. Air is rapidly circulated over the strip heater, through the oven and back to the fan. There is also an automatic humidity control system whereby steam and water spray are used to maintain the proper humidity. The operating temperature of the kiln is 150 Fahr., which is automatically maintained. The racquets while being dried in the kiln are held firmly in forms or braces to prevent warpage.

A stencilling or transfer machine for putting the trade mark on tennis balls consists of a plunger which is electrically heated with a 275-watt cartridge unit. When the mechanism is operated, the heated plunger presses the transfer tape against the ball held in place by the operator.

ELECTRICALLY HEATED LUBRICANT TESTER

Industry has for a long time wanted a machine that would accurately determine the load carrying capacity of lubricants, and friction and wear characteristics of various materials under given conditions of service.

A prominent manufacturer of roller bearings, feeling the need of an accurate testing machine, developed such a machine for use in his laboratory. The simplicity of the machine, requiring no particular skill or training on the part of the operator to get accurate results, has prompted this company to place the machine on the market for use by industry in general.

The testing machine answers some very pertinent questions that have been difficult of solution before. It is designed to test the load carrying capacity of film strength of lubricants, particularly those beyond the range of viscous lubrication and is, therefore, desirable for testing "extreme pressure" lubricants.

Tests can be made to show accurately comparative load carrying capacity of lubricants at constant rubbing speeds and the maximum load a lubricant will stand before the film breaks down. These tests can be made as applying to any operating condition as to load, speed, or temperature.

The determination of friction depends on load, rubbing speed, materials in contact, temperature, and lubricant. Changing any one of these factors may change the friction. The testing machine, with its lever system including a friction arm with a Vernier scale and sliding weight for obtaining accurate measurement, makes it possible to get accurate reading of friction at the test surfaces and thus get a direct reading of the coefficient of friction. The friction at various rubbing speeds can be accurately measured. Likewise, the friction may be measured when the rubbing speeds and bearing materials are held constant and the lubricants changed, or when the bearing materials are changed and all other factors held constant.

The testing machine, although primarily designed for testing lubricated surfaces, can be used to test such materials as packings, metal products, wood products, textiles, etc., for wear by simply comparing test samples by weighing the specimens before and after the test to determine the amount of material that has been removed during the test.

The testing machine, essentially, consists of a cast-iron base, supporting a testing mandrel, a tank containing the lubricant and a lever system for applying load or friction.

Electric heat in the form of a hot plate utilizing three 275 watt "Spots" of heat (cartridge heaters) performs the very important function of keeping the lubricant at any desired temperature from ambient up to 210 Fahr.

A great many of these testing machines are now in operation in industrial plants and are helping to a better knowledge of lubricants and materials and their properties in meeting the problems of today.

USES OF ELECTRIC HEAT IN THE MANUFACTURE OF SILK HOSIERY

Silk stockings after weaving are washed and dried on forms. For this purpose heated individual forms are often used. These may be steam heated or electrically heated. Normally they consist of a cast aluminum form with a polished surface on which the stockings are slipped and kept for a definite length of time.

Some hosiery mills, however, prefer drying stockings on wooden forms and placing these in an electrically heated oven. The Busy Bee Hosiery Company of Reading, Pa., has several such ovens,

equipped with oven heaters. The ovens have special racks for holding the forms and an easily operated sectional door. The heaters are located in a separate heating chamber entirely baffled from the stockings, and heat transfer is obtained by blowing a stream of air through the heaters and then over the stockings. This air is recirculated in a normal way, so that the proper amount of additional fresh air is added to give proper drying conditions.

After a stocking is finished, prior to shipment, a trade mark is often put on each pair. This may be a paper sticker simply pasted on the toe of the stockings. It may also be impressed in gold leaf on the stocking itself by decalcomania. For this a specially constructed iron is used. One built by a Reading company is typical. It consists of an electrically heated shot attached to a suitable handle and equipped with cord and plug. The heating element is a "Spot" rated 100 watts.

"OVER" HEAT SEED BEDS PRODUCE STURDY TOMATO PLANTS

Three to four kilowatt-hours per day over a month's test sufficed to bring tomato plants grown in 6 ft. square hotbeds to the point of hardening and transplanting. Three types of bed were tested by Earl R. Miller, research assistant at the Oklahoma Agricultural and Mechanical College, and the one in which the heat was supplied above the ground in consuming 112 kwhr. turned out slightly the better plants. Sixty feet of hotbed cable was stapled to the 1-in. framing just above the soil. A second bed had 60 ft. of the cable buried in the soil; this one consumed 97 kwhr. Both were thermostatically controlled to an average temperature of 73 to 79 Fahr. in air and soil, with an average outside temperature of 64 Fahr. The third bed consumed 114 kwhr. was manually operated, and was heated by a 480-watt "Nichrome" coil in an air space below a false board bottom.

The tomato plants broke through in six days. They were thinned to 1 in. in 5 in. rows when 1¾ in. tall. Plants in the "over" heat bed grew a second pair of leaves in the first 13 days (75 Fahr. thermostat setting), while those in the two other beds had only one pair of leaves, somewhat longer, however. Heat for another 17 days (60 Fahr. thermostat setting) and four days of hardening without heat found the "over" heat bed plants 12 in. high with 3½-in. tap roots. The others were 10 in. high with a 5-in. tap root. Both types of seedling behaved the same after transplanting. The conclusion is that there is little choice between the three methods of electric heating of plant beds.

—Electrical World

A NEW COAL TREATING MACHINE

A new coal treating machine recently announced by a Michigan manufacturer makes it possible for the retail coal merchant to dust-proof his coal with a selected paraffin oil at an incredibly low cost.

The machine consists of a motor driven pump which delivers hot atomized oil through special nozzles from a tank heated by a 3 kw. immersion heater and thermostatically controlled. It delivers from 15 to 30 gal. per hour and the preheating of the oil makes possible successful treatment in all kinds of weather as well as facilitating operation the year around.

ELECTRIC HEAT USED FOR TREATING RICE

Rice, after it is bagged, must be properly sterilized before it is shipped. Unless this is done, it may spoil while in storage, due to fungus growth or the action of certain pests.

This sterilization is accomplished by subjecting the bagged rice to the action of a chemical gas in a steel chamber for an extended period of time. This gas is of such a nature that it will not support combustion. In order to make this sterilization effective, the temperature of the sterilizing room must be maintained at approximately 80 to 90 Fahr.

A Philadelphia distributor of rice was confronted with the problem of supplying such temperatures in his unheated warehouse during the winter months. He solved the problem by installing in the sterilizing room a 3 kw. Industrial Air Heater.

FOREIGN PRACTICE ON INSULATING OILS

(Continued from page 188)

failures in any of our equipment due to failure of the insulating oil."

RECOVERY OF INSULATING OILS

Foreign methods of recovering insulating oils include the usual methods employed in America, namely—centrifuging and filtration. Describing the methods used by "SOFINA," Lucien Janlet declared:

"The tests carried out to investigate the effectiveness of methods of regeneration of particular oils have shown very clearly that by the ordinary methods of purification: centrifuging, filtration, ultra-filtration, heating under ordinary pressure or under vacuum, centrifuging in a vacuum, one obtains only an oil cleaned mechanically from its humidity, impurities and deposits, the organic acidity not being changed. In order that it can be reemployed effectively it is necessary that the oil be actually regenerated and this can only be done by a chemical process; neutralization of the organic acidity by a soda wash, precipitation of the deposits by sulphuric acid and filtration on an absorbent earth. One of our plants has in service a regenerating apparatus with a capacity of 300 litres or about 80 gallons; the efficiency of the operation is very favorable especially for oils having an index of acidity not too high. As one can find oils having all possible degrees of wear, one will modify and simplify the process according to the circumstances; treatment with earth sufficing when the oil is only dirty, the treatment with soda being on the other hand useless when the oil has a negligible organic acidity.

"Centrifuging is a purifying process the effectiveness of which is very doubtful and which is used especially for the elimination of water. Each time that a mechanical purifying is considered necessary, we recommend the use of a filter press. In this case all trace of solid matter, however fine it may be, is retained on the edges of the paper rings, the residue collecting little by little to form finally an enclosing sheath around the column. The simultaneous use of absorbent earth and a filter press has given us very good results under certain conditions."

The Metropolitan Vickers Company, Manchester, England, while using both methods recommends the centrifugal separator as follows:

"The most effective and quickest method of removing moisture from oil is by means of a centrifugal separator. The alternative apparatus is the filter press which we formerly used, but since the development of the centrifugal separator we recommend and generally use the latter. An exhaustive series of tests made in our Research Department showed that a higher degree of drying of the oil could be obtained by the centrifugal separator as compared with the filter press. Operation and maintenance of the centrifugal separator is also considerably less as it avoids the continual changing out and washing or replacement of the filter papers and the time and cost associated therewith.

"If a separator is not available the most convenient method for use on site is that of heating the oil while in the transformer tank by means of resistance units resting on the tank bottom, these units being distributed over the tank area. The same procedure is followed as in the case of transformer drying out method, i.e., the oil is raised to a temperature of about 105 deg. C., the tank being lagged to prevent loss of heat and the tank cover removed (when the oil has reached a sufficiently high temperature) to permit escape of the water vapour. Attention is drawn to the desirability of using as large a number of grids as possible in order to avoid the formation of excessive local heat. The dissipation of 5 Kw per 100 gallons of oil should raise the oil temperature to about 105 deg. C. in approximately 36 hours."

POWER SALES ITEMS

AIR CONDITIONING

"Possibilities and Problems of Air Conditioning for Buildings," D. W. McLenegan. Engineering & Contracting, July 26, 1933, pp. 727-30 and Aug. 2, pp. 745-8. Gillette Publishing Co., 400 West Madison Street, Chicago, Ill.

Modification of climate by air conditioning processes; determination of heating and cooling; typical energy requirements of home air conditioning equipment in Toronto; conditions recommended for house cooling; typical annual load chart for air conditioned house; mechanical heat pump for heating and cooling.

"Residence Cooling Problem," A. C. Willard and A. P. Kratz. Refrigerating Engineering, August, 1933, pp. 73-81 and 101. American Society of Refrigerating Engineers, publisher, 37 West Thirty-ninth Street, New York City.

Investigation of summer cooling in Research Residence at University of Illinois; character of cooling load; variability of cooling load from season to season; possibility of reducing cost of residence cooling by circulation of outside air at night.

"Air Conditioning and Ventilating 31-Story Office Building," E. C. Parker. Heating and Ventilating, August, 1933, pp. 14-9. The Industrial Press, 148 Lafayette Street, New York City.

Description of air conditioning system of new Home Office of Metropolitan Life Insurance Company, New York; water and steam service; electric service and fire protection; operation and maintenance.

"An Air Conditioning Catechism," by the Editor of the Aerologist. Aerologist Publishing Co., 121 N. Clarke Street, Chicago, Ill.

This Catechism covers in a concise manner some of the underlying principles of air conditioning.

"Shorter Weeks and Indoor Cooling," J. E. Bullard. The Aerologist, August, 1933, The Aerologist Publishing Co., 121 N. Clarke Street, Chicago, Ill.

This article gives a brief discussion of the effects of air conditioning on business and industry in general and it specifically covers its effects on fatigue, the relations between machines and operators and the relationship between increased sales and proper air conditioning.

"Many Economies Made by Using Air Conditioning in Ripening Fruits," James J. Murray. Heating, Piping and Air Conditioning, July, 1933, pp. 352-3. Engineering Publications, Inc., 1900 Prairie Avenue, Chicago, Ill.

With the introduction of conditioned air in the ripening room the fruit is made marketable about three weeks sooner than it was with the old make-shift method and the spoilage is cut down, increasing the dealer's profit.

BREWERIES

"Refrigeration, the Control Factor in Brewing," A. B. Stickney. Refrigerating Engineering, August, 1933, pp. 70-2 and 95. American Society of Refrigerating Engineers, 37 West Thirty-ninth Street, New York City.

Refrigerating load; importance of refrigeration in brewing; modern refrigeration practice as applied to brewing.

DIESEL ENGINES

"Allerton House Says Good-bye to Purchased Power for Ice Making," G. Grow. Diesel Power, July, 1933, pp. 445-6. Business Journals, Inc., 192 Lexington Avenue, New York City.

Management has been operating heating boiler plant and purchasing its electricity for lighting and power to drive various building equipment; to reduce operating expense study was made of electrical equipment and it was found that compressor motor offered easiest method of reducing electrical bill; as consequence, 16-hp., 2-cyl., 4½-in., 800 r.p.m. Diesel was purchased and arranged to drive compressor through 10-ft. center belt; savings obtained.

"Oil and Gas Power," Electrical Engineering, July, 1933, p. 499. American Institute of Electrical Engineers, 33 West Thirty-ninth Street, New York City.

Several progressive features are evidenced in the Diesel engine field, such as reduction in weight, use of trunk pistons of large diameter, and increased speed. The increased use of alloy steels is noticeable, also the discontinuance of air injection in favor of mechanical injection. The trend in small plants is largely to the use of the single-acting 2-cycle engine. The city of Vernon (Calif.) Power Plant will contain five 7000 hp. double-acting 2-cycle engines and will form the world's largest Diesel-electric power plant. Each engine has 8 cylinders, 24-in. by 36-in., runs at 167 r.p.m., and will drive a 5000 kw. generator.

DIESEL ENGINE FUELS

"Tests on Blended Fuel Oil at U. S. Submarine Base." Diesel Power, July, 1933, pp. 464-6. Business Journals, Inc., 192 Lexington Avenue, New York.

In cooperation with Fuel Oil Research work of Oil and Gas Power Division of American Society of Mechanical Engineers, United States Submarine Base, New London, Conn., is conducting series of tests on Diesel fuels made up of blend of residue and cracking still distillate; test data tabulated.

ELECTRIC DRIVE

"Constant Tension Regulator on Reels and Unwinding Stands," R. H. Smith. Paper Trade Journal, June 22, 1933, pp. 31-3. Lockwood Trade Journal Co., Inc., 15 West Forty-seventh Street, New York City.

Advantages gained by adopting to paper-mill requirements constant-tension regulator of rotative element type which already is being used successfully in other industries, this regulator automatically controlling tension in winding or unwinding of web or material; principle upon which it operates. Before American Pulp and Paper Mill Superintendents Ass'n.

"Some Special Power Problems Relating to Rolling Mills," S. Calander. Sheet Metal Industries, August, 1933, p. 203-5. Sheet Metal Industries, 49 Wellington Street, London W. C. 2, England.

Load diagram for rolling-mill motor; advantages to be gained by use of automatically regulated slip resistances; group classification of cascade connections. Before World Power Conference.

ELECTRIC HEATING

"Low Temperature Radiant Heating," L. W. Schad. Electrical Engineering, July, 1933, pp. 467-71. American Institute of Electrical Engineers, 33 West Thirty-ninth Street, New York City.

This article describes experiments in the heating of a small room by controlled radiation from electrically heated panels in the walls; from the results has been determined a practical method of predicting relative comfort for various combinations of wall and air temperatures. It is claimed that low temperature radiant heating in combination with reversed refrigeration would so lower the operating cost of electric heating as to make it competitive with heating by other fuels.

"These Two Jobs Show Application of Electric Heating to Office Buildings," Lee P. Hynes. Heating, Piping and Air Conditioning, July, 1933, pp. 358-60. Engineering Publications, Inc., 1900 Prairie Avenue, Chicago, Ill.

For information on heating industrial plant electrically, see "Auxiliary Electric Heating With Off-Peak Power, a Method of Cutting Cost," Heating, Piping and Air Conditioning, October, 1932, p. 658.

The actual cost of operation is always of interest, but with electric heat no general data comparable to fuel costs can be given because of the great variation in power rates. The larger the building, the less opportunity exists to utilize electric heating with economy, but for moderate-sized jobs it has many advantages wherever electric power can be purchased at sufficiently low rates to provide from 5000 to 10,000 B.t.u. per each cent of cost for power. Even at considerably higher rates, it is frequently justified where its particular features are the main consideration.

ELECTRIC MELTING

"Electric Furnace Iron Used for Piston Rings and Valve Tappets," F. Erb and E. Bremer. Foundry, July, 1933, pp. 45-6 and 60. The Penton Publishing Co., Penton Bldg., 1213 West Third Street, Cleveland, Ohio.

Manufacture of electric-furnace iron at Eaton-Erb Foundry Co., Vassar, Mich.; features and sand casting foundry; two furnaces of rotating, indirect arc type, manufactured by Detroit Electric Furnace Co.; weighing feature important in duplexing; gray-iron piston ring.

ELECTRIC MOTORS

"Centrifugal Extractor Motors," C. A. Kelsey. Facts About Sugar, August, 1933,

pp. 323-6. Russell Palmer, Publisher, 153 Waverly Place, New York City.

Problems requiring consideration in fitting motor installation to demands of job.

INDUSTRIAL STEAM PLANTS

"'A New Deal' in Industrial Power Supply," Power Plant Engineering, July, 1933, pp. 282-8. Technical Publishing Co., Monadnock Block, 53 West Jackson Blvd., Chicago, Ill.

Jacob E. Decker & Sons Power Plant built on self-liquidation plan is a revolutionary departure from traditional packing plant engineering and the unique financing arrangement by Power Service Corporation opens up new avenues to industrial power plant expansion.

CORRESPONDENCE

"The Value of the Service—and What It Means to Every Stockholder"

To the Editor:

Our attention has been called to your statement on Page 30 of your May issue and to the article signed with the initials "C. E. G." ending with this paragraph:

> "The value of the service for the price paid has yet to be effectively told throughout the entire utility field."

In view of this statement we thought you would be interested in our current bulletin, "The Value of the Service—and What It Means to Every Stockholder," mailed as our Shareholders Dividend Letter for September.

H. E. Weeks,
Vice-Pres. and Gen'l Mgr.,
United Power Securities Co.
Davenport, Iowa.

The bulletin referred to follows:

As a stockholder in a big gas and electric company you probably have noticed that many people habitually speak of their monthly bills for these services as "too high."

Now by what standard of value does the customer come to this judgment? Does he imagine the company's earnings are too large, that rates are higher in his community than elsewhere, that the price of these indispensable services has not been reflected in changed conditions and is out of line when compared to the cost of living or commodity price index? Or is it the customer's opinion that the management is unbusinesslike and extravagant? Or does he believe he could duplicate for less money a lighting and power service equal to electricity or an efficient and satisfactory fuel substitute for gas? Or is there a possibility that the modern domestic and commercial appliances are wasteful in the power and fuel energy they consume?

Or, on the other hand, is the public point of view rather the result of a prejudice originating in political utterances and actions? Or, still again, have the gas and electric companies shown poor salesmanship in not convincing the public of the value of their services? Probably all of these questions and others as well come to the mind of the thinking stockholder as he hears a consumer object to gas and electric bills as "too high."

If these then are fair and reasonable queries as to why the customer holds the opinions he evidently does hold on the value of these services, then the stockholder is surely concerned enough to look further into the situation and discover whether the public's opinion has grounds for justification. If he should conclude the customer is right, then the stockholder is within his privilege as such in offering constructive suggestions to his company's management. But, on the other hand, if the public conception of the value of gas and electric services is erroneous and unjust in his opinion, then it is to the stockholder's own interest to correct the situation as far as lies within his power by enlightening such of the misinformed as he can reasonably contact in the course of business and social activities.

At first thought this may seem an uncalled-for line of action. But if a policy of this sort had been followed by the security holders of American railroads, it is only reasonable to conclude that great basic industry would never have been throttled to within an inch of its life nor would its stocks and bonds have depreciated so greatly in value.

Now to consider the charge that gas and electric bills are "too high" on the ground that the company's earnings may be too large. The best answer to this line of reasoning is that the law of the land itself fixes the limit of return which any utility company can receive on its invested capital at 8%. No greater per cent may be earned even in good times, when other industries are allowed to make enormous profits and still not come under public censure. Earnings of the United Light & Railways Company are far under the legal limit at this time and have been so for a long period. The depression has hit this company just like everyone else. In fact, earnings have not yet begun to show an upward trend.

The same condition applies to the gas and electric industry throughout the United States. Total electric revenues for the first six months of 1933 amounted to $879,576,700 against $939,404,700 for the corresponding period of 1932, a decrease of $59,828,000 or 6.4%. And 1932, we must remember, was the worst year in the recent history of the industry, revenues in some cities falling 50 to 75% from 1929. The shrinkage in one typical United Light community was over 27%.

That the gas business is also still in a slump is shown by the fact that total revenues of manufactured and natural gas companies for May of this year were $55,563,700 as against $59,682,600 for May of 1932, a decrease of $4,118,900 or 6.3%. And again, 1932 was a bad year for typical United Light gas companies, a revenue decrease of 25% from 1929 not being uncommon.

If earnings of gas and electric companies have not been too large and bills are yet "too high," then it is possible that some other standard such as the average rates of other communities or comparative general price levels will support the allegation. However, communities served by your company enjoy rates lower than the rates in effect in comparable communities. Again, using the price level rule to evaluate electric and gas services we find electricity used in domestic purposes, for instance, selling at 35% LESS than in 1913 whereas the cost of living has INCREASED 35% above the pre-war level and commodity prices are still up 32% from the same mark.

Since by none of these standards can we substantiate the theory that gas and electric bills are "too high," we must peer into another closet of the utility house and see what we can find. Possibly the management is at fault. Your company's affairs, however, are in charge of men trained in all the details of operation through years of experience. They have in most cases grown up with the company, are devoted to its interests and are not unmindful of their responsibility to the public. Their ability is not questioned by the many state commissions and municipal officers who come into contact with their policies and acts of management.

This, then, brings us to the possibility that gas and electric bills are "too high" on the grounds that these services can be duplicated elsewhere for less money. Let us see if such is really the case. Take mechanical refrigeration, for instance. Careful tests have shown that for only nine cents worth of gas or electricity—the price of a quart of milk, you can keep your refrigerator operating and foods fresh and appetizing for more than 36 hours. Now what substitute service would prove of equal value? Would a 9-cent piece of ice go as far—be as convenient, dependable and satisfactory? "No, it would not" any fair-minded housewife would admit.

Or translate the value of electric service into terms of entertainment—your favorite radio program, for instance. For this popular use it has been repeatedly demonstrated that a penny's worth of electricity will keep an average set going for an hour. Now even the cheapest movie would not provide entertainment at ten times that cost. So here again the complaint of high cost fails by comparison.

Just one more example—domestic cooking with either gas or electricity. In any community where these United Light services are available and at existing rates, you can prepare a meal for an average family at the cost of four cents—less than a penny a plate. This leaves small prospect of economies through substituting oil, coal, wood or other fuels. At prevalent prices they would prove more expensive as well as less convenient. In fact, at existing United Light rates every household task can be performed with gas and electricity at less cost than in any other manner.

Now we are coming to see that we must view from an entirely different angle this customer conception of his gas and electric bill as being "too high" if we are to find the key to this puzzle. Has the picture purposely been painted dark from the palette of prejudice held on the thumb of the radical politician? The career of almost any demagogue will answer this question with "Yes." Candidates for public office invented the "Power Trust." On election campaigns many political knapsacks have bulged with such half-hewn planks as "Lower Rates," "More Regulation" and "Public Ownership." Having landed the office with this bait, they have not had the courage to admit the campaign deception and the impossibility of carrying out their proposals. Therefore, to save their face, they have gone on unfairly attacking the utilities. In the last analysis, radical propaganda is responsible in the most part for the delusion that gas and electric bills are "too high."

The utility picture should be presented to the public in its true light. A more aggressive attitude on the part of the entire industry is necessary. Likewise necessary is a willingness and ability on the part of the stockholder to protect his own interests by correcting existing misconceptions wherever found—particularly the idea that just because they are gas and electric bills they are "too high."

The rates, policies and practices of the United Light companies are fair and honorable. If you will call at our local offices, facts and figures will be furnished you demonstrating that no dollar will buy more value than that spent for gas and electricity.—*The United Power Securities Company.*

REVIEWS

PULVERIZED FUEL 1932-1933

Report of former Prime Movers Committee, published by Edison Electric Institute. Pub. No. A-6. Price 75c. to members and their employees; $1.85 to non-members; $2.00 to foreign countries.

This report includes installation and operating data from 43 operating companies covering 181 boiler units, showing a trend in favor of the Direct Fired as against the Bin System.

Statements from 14 operating companies are given covering:

1—Direct or Bin System
2—Coal Feed Interruptions
3—Operation and Maintenance
4—Mill Performance
5—Mill Drying and Dust Removal
6—Furnace Bottoms
7—New Developments
8—Corrosion

Statements are included from seven manufacturers, including one in detail covering a process for the fabrication of building brick from fly ash.

ELECTRIC ROASTING OVENS FOR COMMERCIAL KITCHENS

A report of the former Commercial Cooking Committee, published by Edison Electric Institute. Pub. No. A-15. Price 20c. to members and their employees; 50c. to non-members; 60c. to foreign countries.

The volume of oven cooking performed in the commercial kitchen indicates the Electric Roasting Oven as an equipment with large load building possibilities and high revenue per kilowatt of connected load. Facts and figures on the merits of the Electric Roasting Oven make this piece of commercial cooking equipment an outstanding choice as the logical second step in eventual 100 per cent electrical cooking for commercial kitchens.

This report covers:

Value of the Roasting Oven Load
Development of Electric Roasting Ovens
Design of Electric Roasting Ovens
Electric Roasting Technique
Electric Roasting Practice
Features of the Electric Roasting Oven

PROMOTION OF HOME AIR CONDITIONING

A report of the former Home Air Conditioning Committee, published by Edison Electric Institute. Pub. No. A-17. Price 20c. to members and their employees; 50c. to non-members; 60c. to foreign countries.

The aim of this non-technical report is to present suggested plans, methods, and some of the results already obtained in the promotion of Air Conditioning in the home.

The report:

Defines Home Air Conditioning
Offers a few suggested sales plans for organizing and promoting Home Air Conditioning
Presents briefly special information, publicity and sales activities pertaining to Home Air Conditioning development as now in use by a number of member companies.

STOKER EQUIPMENT AND FURNACES

Report of former Prime Movers Committee, published by Edison Electric Institute. Pub. No. A-7. Price 60c. to members and their employees; $1.50 to non-members; $1.60 to foreign countries.

This report contains information on recently installed stokers, fans, air compressors, and combustion control with special reference to maintenance problems and operating results.

Changes in operating methods and in details of stoker construction to improve efficiency and decreased costs are covered by detail statements.

The development of zoned air control has improved stoker performance.

RECENT PUBLICATIONS

A number of reports, prepared by committees of the National Electric Light Association prior to their dissolution, were transferred to the Edison Electric Institute by the Liquidating Committee of the N.E.L.A. Because of the value to the industry of the material contained in the reports they have been published by the Institute and may be purchased at the following prices:

Pub. No.	*Foreign Systems Coordination Committee*	*Price to Members*	*Price to Non-Members*	*Price to Foreign Countries*
A13	Power System Wave Shape	$0.20	$0.50	$0.60
	Hydraulic Power Committee			
A18	Economic Design of Hydro-Electric Plants	.20	.50	.60
A19	Hydraulic Governors	.20	.50	.60
	Power Systems Engineering Committee			
A16	Load and Revenue Forecasting	.30	.75	.85
A11	Load Area Development	.30	.75	.85
	Prime Movers Committee			
A4	Burning of Liquid and Gaseous Fuels	.30	.75	.85
A5	Power Station Chemistry	.40	1.00	1.10
A6	Pulverized Fuel	.75	1.85	2.00
A2	Station Piping	.60	1.50	1.60
A7	Stoker Equipment and Furnaces	.60	1.50	1.60
A3	Turbines	.75	1.85	2.00
	Underground Systems Committee			
A9	A-C Network Operation—1931	.20	.50	.60
A10	Cable Operation—1932	.45	1.15	1.25
A14	Current Carrying Capacity of Impregnated Paper Insulated Cable	.25	.65	.85
A12	Fault Locating Methods Used on Underground Cable Systems	.40	1.00	1.10
	Sales Section			
A15	Electric Roasting Ovens	.20	.50	.60
A17	Promotion of Home Air Conditioning	.20	.50	.60
	General			
A1	The Electric Light and Power Industry, 1932	.30	.75	.85

The prices include mailing charges. Member prices apply to employees of company members of the Institute. Please send money order or check with order. Orders should be addressed to—

EDISON ELECTRIC INSTITUTE
420 Lexington Avenue, New York, N. Y.

The Institute has in stock a limited number of reports prepared by Engineering Committees of the former National Electric Light Association during the past several years. These reports may be ordered from the Institute from the price lists issued by the N.E.L.A., or a new list will be forwarded upon request.

Data are given of furnace temperatures and operating conditions for bare water walls in comparison with air-cooled furnaces and refractory faced water-cooled walls.

Air preheater corrosion and fouling problems are discussed by several users.

Several manufacturers' statements outline the new developments in this field.

HYDRAULIC TURBINE GOVERNORS

Report of former Hydraulic Power Committee, published by Edison Electric Institute. Pub. No. A-19. Price 20c. to members and their employees; 50c. to non-members; 60c. to foreign countries.

This report discusses recent developments in hydraulic governor design and operation. It supplements and brings up to date the report entitled "Hydraulic Turbine Governors and Frequency Control," published in December, 1930.

THE ECONOMICAL DESIGN OF HYDRO-ELECTRICAL PLANTS

Report of former Hydraulic Power Committee, published by Edison Electric Institute. Pub. No. A-18. Price 20c. to members and their employees; 50c. to non-members; 60c. to foreign countries.

This report points out the path that hydroelectrical development is taking, and shows some of the savings which can be made in future developments based on recent experience. The report discusses low head plant design, high head plant design, mechanical equipment for hydro stations and hydraulic structures.

THE HARNESSED LIGHTNING

(*Continued from page* 176)

once entertained, was difficult to relinquish. The pathetic bankruptcy of the cabinet in the corner was an aggravation, but nothing could be done about it—it was as lifeless as a stone.

"In the more remote suburbs there was no magic force to operate the household pumps, and families necessarily did without a fundamental supply of water. There, too, telephone lines were down, and homes therefore were isolated from contact one with the other.

"Had it been Winter there would have been trouble with the oil-burning furnaces, which require electricity for their operation, relied upon for heating.

"Altogether, the downpour and the gale had taught the community a lesson. The event proved the electric aspect of the age. Humanity, it was made clear, is living in an electric world. The fact has been taken for granted, but its meaning never was more dramatically demonstrated."

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CONVENTIONS AND MEETINGS

SEPTEMBER

4-8 American Institute of Electrical Engineers, Pacific Coast Meeting, Salt Lake City, Utah.
6-8 Pennsylvania Electric Association, Bedford Springs, Pa.
11-13 Rocky Mountain Electric Association, Santa Fe, N. M.
11-15 International Association of Electrical Inspectors, Chicago, Ill.
18-20 American Transit Association, The Stevens Hotel, Chicago, Ill.
20-30 National Electrical Exposition, New York, N. Y.
25-29 American Gas Association, Chicago, Ill.

OCTOBER

2-6 American Welding Society, Detroit, Mich.
2-6 National Safety Council Congress, The Stevens Hotel, Chicago, Ill.
10-13 National Association of Railroad and Utilities Commissioners, Cincinnati, Ohio.
15-19 National Electrical Contractors Association, Indianapolis, Ind.
17-19 Association of Iron and Steel Electrical Engineers, Pittsburgh, Pa.

ANOTHER RACKET

(*Continued from page* 184)

be had for a dollar. This is an amplification of the claims made in the circular. It is characterized by the same definiteness in quoting fragments from recognized authority, coupled with vagueness and indefiniteness in the conclusions drawn from such quoted matter. In no place is the claim definitely made that cancer, appendicitis or carious teeth are attributable to the increased use of foods mechanically refrigerated, except in the title of the booklet. The inference, however, is drawn so that the uncritical reader will inevitably make his own deductions to that effect.

"Whatever may be the motive which inspires this propaganda, it may be said definitely that there is no scientific evidence to support the claims. The circulation of such unfounded literature conjures weird phobias among its readers and is prejudicial to the public health because it diverts attention from real problems and discredits genuine health education. If there is any method by which it can be reached, it should be stopped."

ROBERT LINDSAY

(*Continued from page* 189)

and social organizations in Cleveland and New York he esteemed most highly his membership in The Edison Pioneers, an exclusive organization of the men who were associated with Mr. Edison in the pioneering days of the electrical industry.

In the fall of 1932, his health failing, Mr. Lindsay and his wife, Ellen Evers Lindsay, took an estate at University, Va., with the expectation that a rest and the change in climate would quickly restore his health. However, he actively continued his duties as chief executive of the illuminating company, and as a Director of The North American Company, majority stockholder in the illuminating company.

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